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Highway Safety Literature

An Announcement
of Recent Acquisitions . . .

HSL No. 71-28
November 5, 1971



THIS ISSUE CONTAINS:

HS-009 996 - HS-010 078
HS-800 474, 496 - 499
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11/1/71

HIGHWAY SAFETY LITERATURE

AN ANNOUNCEMENT OF RECENT ACQUISITIONS

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INTRODUCTION

Publications announced in *Highway Safety Literature* include the most recent additions to the collection of the NHTSA Scientific & Technical Information Service. Subject areas covered include all phases of highway, motor vehicle, and traffic safety, especially those encompassed by the National Traffic and Motor Vehicle Safety Act of 1966 and the Highway Safety Act of 1966.

Individual issues of *HSL* are numbered according to the year and the issue number within that year; thus, 71 designates the year and 1, 2, 3, etc. the individual issues. To aid the user in location citations by the HS-number, the cover bears the inclusive entry numbers for each issue.

Entries in *HSL* are arranged according to the revised NHTSA Subject Category List shown in the Table of Contents. The list is a two-level arrangement consisting of five major subject fields subdivided into 59 subject groups. Documents related directly to the National Highway Traffic Safety

Administration (NHTSA) are announced in a separate section headed NHTSA DOCUMENTS and are numbered in five distinct series: NHTSA Accident Investigation Reports (HS-600 000 series), NHTSA Compliance Test Reports (HS-610 000 series), NHTSA Contractors Reports (HS-800 000 series), NHTSA Staff Speeches, Papers, etc. (HS-810 000 series), and NHTSA Imprints (HS-820 000 series). For NHTSA DOCUMENTS in series HS-600 000 and HS-610 000, individual full case reports are available for inspection at the National Highway Traffic Safety Administration. HS-800 000 series and HS-820 000 series are available for sale/or purchase from NTIS or GPO (see page ii). Although announced together in a separate section, these documents are also assigned specific subject categories for machine retrieval.

A document which contains a number of separate articles is announced as a complete volume in the subject category most applicable to it as a whole. Entries for the individual articles appear in their most specific subject category.

SAMPLE ENTRIES

Subject Category Array

NHSL Accession no..... HS-800 218 Fld. 5/21; 5/9

Title of document..... AN INVESTIGATION OF USED CAR SAFETY STANDARDS-SAFETY INDEX: FINAL REPORT. VOL. 6 - APPENDICES G-L

Personal author(s)..... by E. N. Wells; J. P. Fitzmaurice; C. E. Guilliams; S. R. Kalin; P. D. Williams

Corporate author..... Operations Research, Inc.

Collation

Publication date..... 12 Sep 1969 150p
Contract FH-11-6921
Report no. ORI-TR-553-Vol-6; PB-190
523

Abstract..... Appendices G-L to this study of used car safety standards include: indenture model diagrams for classes I-IV motor trucks; degradation, wear, and failure data for motor truck classes I-IV; and safety index tables for classes I-IV motor trucks.

Search terms; Wear; Trucks,
Failures; Used cars; Inspection
standards

HS-004 497 Fld. 5/19

AUTO THEFT-THE PROBLEM AND THE CHALLENGE

by Thomas A. Williams, Sr.

Journal citation . . . Published in *FBI Law Enforcement Bulletin* v37 n12 p15-7 (Dec 1968)

Gives figures on the extent of the auto theft problem and comments on antitheft devices available now or in the planning stage.

Search terms: Theft; Theft protection; Stolen cars

AVAILABILITY: NTIS

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NOTE: () Numbers in parentheses following certain subject groups indicate the Highway Safety Program Standards (No. 1, and up) and/or Federal Motor Vehicle Safety Standards (No. 101 and up) which may apply to these groups.

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NOTE: Material published in Highway Safety Literature (HSL) is intended for the information and assistance of the motor vehicle and highway safety community. While brands names, equipment model names and identification, and companies may be mentioned from time to time, this data is included as an information service. Inclusion of this information in the HSL should not, under any circumstances, be construed as an endorsement or an approval by the U. S. Department of Transportation, National Highway Traffic Safety Administration of any particular product, course, or equipment.

Harry A. Feinberg
Managing Editor

AVAILABILITY OF DOCUMENTS AND INSTRUCTIONS FOR ORDERING

Department of Transportation personnel may borrow copies of publications directly from the NHTSA. Outside the Washington, D.C. area, phone (202) 426-2768. In Washington, D.C. area, use government ID, phone 118-62768. Non-DOT personnel should contact their company or agency libraries for assistance.

Journals cite¹ may be obtained through most research libraries.

Contractors' reports and other documents can usually be obtained as indicated under AVAILABILITY. However, there is no certainty that retention copies will be available for more than a limited period after a document is issued.

The more common distribution sources are identified by symbols which are explained below:

NTIS: National Technical Information Service, Springfield, Va. 22151. *Order by accession number: HS, AD, or PB.* Prepayment is required by NTIS (CFSTI) coupon (GPO coupons are not acceptable), check, or money order (made payable to the NTIS), HC (Paper copy; full size original or reduced facsimile) \$3.00 up; MF (microfiche approximately 4x6" negative sheet

film; reader required) \$0.95.

GPO: Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402. Give corporate author, title, personal author, and report number. Prepayment is required by GPO coupon (NTIS [CFSTI] coupons are not acceptable), check or money order (made payable to the Superintendent of documents).

HRB: Highway Research Board, National Academy of Sciences, 2101 Constitution Ave., N. W., Washington, D. C. 20418.

NHTSA: National Highway Traffic Safety Administration General Services Division, Washington, D.C. 20591 (Telephone (202) 426-0874),

SAE: Society of Automotive Engineers, Dept. HSL, 2 Pennsylvania Plaza, New York, N.Y. 10001. Order by SAE report numbers. Prices given are list; discounts are available to members and sometimes to libraries and U. S. Government Agencies. Prepayment is required; orders without payment are subject to a \$1 handling charge.

IMPORTANT NOTICE

WHEN REQUESTING a document, to be absolutely sure you receive what you order, give the accession number (HS, PB, AD number) or report number (in cases such as an SAE document), title of report, and the personal or corporate author (whichever is cited). When requesting an HS-numbered document from NTIS (CFSTI), add DOT/to the prefix HS-; example HS-800 000 should be ordered as DOT/HS-800 000.

1/0 ACCIDENTS**1/2 Injuries****HS-009 996 Fld. 1/2****CAUSES OF DEATHS IN AUTOMOBILE ACCIDENTS. CAN SEAT BELTS REALLY SAVE LIVES?**

by Paul W. Gikas; Donald F. Huelke

Published in *Journal of Michigan State Medical Society* v63 n5 p351-4 (May 1964)2 refs
Grant PHS-AC-00107

The results of a detailed personal investigation of 79 deaths in automobile accidents are presented with special emphasis on correlating patterns of injury of the victims with patterns of damage to the vehicle and occupant compartment. This correlation was also applied to ejection or retention within the vehicle. It was found that a minimum of 34% of the victims would have survived if a simple lap-type seat belt had been worn. Another 11% would have probably survived with a shoulder strap-lap belt combination. The influence of certain features of the interior design of motor vehicles on the type of fatal injury is discussed.

Search terms: Seat belt usage; Michigan; Accident investigation; Shoulder harness usage; Automobile interior design; Fatalities; Fatality causes; Accident survivability

HS-009 997 Fld. 1/2**TRAUMA CAUSED BY IMPACT AND BLAST**

by John P. Stapp

Published in *Clinical Neurosurgery* v12 p324-43 (1964)

23 refs

The spectrum of trauma resulting from exposure to mechanical force resolves into effects of interaction between mechanical properties of body components and the combination of force factors to which they are vulnerable. These factors include the rate of application, duration and rate of reversal of blast pressure, the direction relative to the long axis of large blood vessels, and the rate and magnitude of onset and rebound for forces ramming fluids in the body to injurious hydraulic pressures. Amplification of applied impact force at onset rates that excite resonant response of masses linked by viscous-elastic body structures and similar excitation of bell-clapper oscillations of organ masses against inclosing rigid body walls will produce injury. Absorbed heat and repeated buffeting displacement of internal organs during sustained sinusoidal vibration at frequencies matching body resonance responses are damaging. Differences in the effects of injury are related to methods of restraining and supporting the body. Impact sled tests with animals are discussed briefly.

Search terms: Restraint systems; Impact forces; Blast injuries; Impact sleds; Sinusoidal vibration tolerances; Force; Occupant protection; Human body impact tolerances; Injury factors; Injury tolerances; Human tissue mechanical properties; Viscoelasticity; Oscillation; Animal experiments

1/3 Investigation**HS-009 998 Fld. 1/3****PILOT STUDY OF SCHOOL-AGE ACCIDENTS AND EDUCATION**

by S. A. Abercrombie; Norman Key

National Education Assoc.

Feb 1963 128p 33 refs
Grant PHS-AC-72

This study, extending over a two-year period, was designed to investigate the kinds and extent of relationships

between accident incidence among school-age children (grades 2 through 12) and their educational experiences. Information on 2,018 accidents was studied. Demographic, biographic, and school-related variables were obtained from student records. Safety regulations, school plant appraisals, textbook safety content, student safety knowledge and attitudes, teacher orientation to safety instruction were studied. Several school success variables such as high test scores showed fairly high intercorrelations with accidents. Parental occupation showed the closest relationship to accidents among the biographic variables for rural boys. The higher the occupational level, the higher the number of accidents. The study was conducted in northern Virginia.

Search terms: Child injuries; Children; Accident factors; Safety education; Safety programs; Accident rates; Occupation; Virginia; Child safety education; Sociological factors; Accident studies; Instruction materials; Attitudes; Variables; Parents

HS-009 999 Fld. 1/3; 4/7**NUMBERS OF ACCIDENTS PER DAY AND TIMES BETWEEN ACCIDENTS**

by Roger A. Chapman

Published in *Traffic Engineering and Control* v12 n2 p82-4 (Jun 1970)

This article consists of several theoretical statements regarding the number of road accidents per time period and the times between accidents. Based on these statements, a formula is proposed for evaluating the effectiveness of road safety measures in terms of a change in time between accidents.

Search terms: Accident rates; Accident prevention; Time of accidents; Poisson density functions; Statistical analysis; Safety program effectiveness; Time of day; Day of week; Probability theory

1/5 Statistical Data**HS-010 000 Fld. 1/5****ACCIDENT FACTS. 1971 ED.**

National Safety Council

1971 100p

This booklet contains an analysis of all kinds of accidents reported during 1970 from data supplied by various national and international organizations. Accidents are analyzed by type: work, motor vehicle, in public places, home, farm, and school. Costs, causes, and trends are reported. Major disasters are listed. Motor vehicle accidents are classified by causative factors of all kinds, driver characteristics, and environmental factors.

Search terms: Accident statistics; Accident causes; Accident costs; Accident factors; Accident location; Accident rates; Accident severity; Driver characteristics; Sex factors in accidents; Accident types; Age factor in accidents; Injury statistics; Fatality rates; Vehicle accidents; Industrial accidents; Injury rates

AVAILABILITY: Corporate author \$2.65 as Stock No. 021.71

HS-010 001 Fld. 1/5**STUDY OF COMPACT VEHICLES REGISTERED IN NEW YORK STATE, 1962**

New York State Dept. of Motor Vehicles

Sep 1963 19p
Report no. RR-8

The study has shown that the increasing popularity of compact automobiles is causing losses of revenue from registration fees and fuel taxes; that these vehicles seem to be involved in a number of accidents which is consistent with the representation in the vehicle population; that their influence is not

restricted to any particular geographic areas of the State; and that the introduction of domestic compact models has contributed most to the rapid growth of this segment of the vehicle population. The difference in vehicle weight may contribute to difficulty in stopping compact cars under slippery road conditions. The involvement of compact cars in accidents on curves and the frequency with which following too closely is assigned as a contributing factor may reflect a reduced line of vision sometimes attributed to compact cars. Design features of compacts, as well as their size and relatively light weight, may be responsible for their lower relative involvement in pedestrian accidents.

Search terms: New York (State); Compact automobiles; Vehicle size; Accident statistics; Accident analysis; Accident types; Compact automobile accidents; Vehicle registration; Fuel taxation; Accident rates; Accidents by vehicle size; Driver age; Driver sex; Environmental factors; Vehicle pedestrian collisions; Vehicle weight; Icy road conditions

HS-010 002 Fld. 1/5**THE SMALL CAR IN MOTOR VEHICLE TRAFFIC ACCIDENTS IN ILLINOIS - 1961**

Illinois Div. of Highways

7 Nov 1962 22p

The purpose of this study was to compare the accident experience of the small car with that of the larger and heavier vehicle. Small cars were involved to the same relative degree in Statewide fatal and downstate injury and property damage traffic accidents as they were represented in motor vehicle registrations. Fatal accident implication was somewhat greater. Relatively more small car drivers were killed in traffic accidents than were drivers of other vehicles. By vehicle group the distribution of passengers killed was similar to that of driver fatalities. Nearly

one in 16, or 6.4% of vehicles registered in Illinois during 1961, were small cars. Registrations of small cars increased 14% over 1960 as contrasted to a gain of 1% for other vehicles.

Search terms: Accident types; Compact automobile accidents; Accident statistics; Fatality rates; Accident severity; Accidents by vehicle size; Injury rates; Driver fatalities; Property damage accidents; Illinois; Accident studies; Age factor in accidents; Driver residence; Environmental factors; Accident location; Accident causes

HS-010 003 Fld. 1/5; 1/3**IS YOUR SMALL CAR REALLY MORE DANGEROUS?**

by Herbert Shuldiner

Published in *Popular Science* v198 n5 p47-9, 118 (May 1971)

Accident and serious-injury rates are compared for different sizes and makes of cars based on four studies: University of North Carolina Highway Safety Research Center (1966 and 1968 data), New York State Department of Motor Vehicles (1968), New Jersey Highway Authority (1968 and first half 1969), and University of Michigan Highway Safety Research Institute (date unstated). The studies indicate serious or fatal injuries are up to three times as common in small car accidents, despite more use of seat belts. Domestic compacts have fewer severe and fatal injuries than foreign small cars. Small cars are more likely to suffer dangerous one-car accidents, and most of their drivers are under 30 years old. The article concludes that uncertainties of exposure and usage preclude a statement that small cars are less safe.

Search terms: Accidents by vehicle size; Accident statistics; Fatality rates; Injury rates; Injuries by vehicle size; Accident risks; Accident severity; Compact automobiles; Foreign automobiles; North Carolina; New York; New Jersey; Young adult drivers; Adolescent drivers

NOVEMBER 5, 1971

ACCIDENTS

HS-010 004 Fld. 1/5; 1/3

HIGHWAY ACCIDENT COSTS
AND RATES IN TEXAS

by Dock Burke

Texas A and M Univ. Texas Transp. Inst.

Dec 1970 120p 31 refs
Report no. RR-144-1F

Sponsored by the Texas Highway Dept. in cooperation with the Federal Highway Administration.

This study develops a method of estimating costs for selected Texas accidents, using cost data developed for accident involvements in Massachusetts, Illinois, New Mexico, and Utah. Given the number and type (car/truck) of vehicles involved and the number of fatally injured persons, accident costs can be derived using the direct cost per involvement and loss of future earnings estimates presented in the report. Also, accident rates for selected highway designs and for various average daily traffic counts are presented and analyzed.

Search terms: Earning capacity; Accident costs; Damage costs; Injury costs; Property damage accidents; Rural accidents; Accident rates; Accident statistics; Accident severity; Traffic volume; Vehicle characteristics; Texas; Automobile accidents; Truck accidents; Accident types; Life years lost in accidents; Fatalities; Accident studies; Life value; Urban accidents; Highway characteristics

HS-010 005 Fld. 1/5; 1/3; 1/4

CHANGES IN THE NUMBERS OF ACCIDENTS AND CASUALTIES ON MAIN ROADS NEAR THE LONDON-BIRMINGHAM MOTORWAY

by R. F. Newby; H. D. Johnson

Published in *Australian Road Research Board Proceedings of the Third Conference*, Sydney, v2 pt1, p558-564 (1964)

3 refs
Report no. 169

This paper compares accident and casualty statistics on main roads in nine counties near the London-Birmingham motorway for one year before and one year after the motorway was opened, and the savings in casualties after the motorway came into use are shown to be in good agreement with predictions made previously. On roads within approximately five miles of the motorway injury accidents were about 20 percent fewer in the year after the motorway was opened, but farther away the reductions were much smaller.

Search terms: England; Accident statistics; Injury statistics; Pedestrian accidents; Moped accidents; Bicycle accidents; Fatality rates; Accident severity; Accident rates; Injury rates; High speed highways; Rural accidents; Urban accidents; Accident risk forecasting

HS-010 006 Fld. 1/5; 4/7

INDUCED EXPOSURE AS A TOOL TO DETERMINE PASSENGER CAR AND TRUCK INVOLVEMENT IN ACCIDENTS

by Donald D. van der Zwaag

Published in *HIT Lab Reports* p1-8 (Jan 1971)

A number of two-car accidents in which only one driver was at fault have been analyzed to determine the relative involvement of drivers of trucks and passenger cars. Data used were taken from Michigan's Oakland County accident files for 1968 and 1969. Results of the analysis indicated that trucks were overinvolved in reportable accidents, at least in this jurisdiction, and that passenger car drivers tend to be overinvolved in accidents at the beginning and end of the driving life span.

Search terms: Truck accidents; Automobile accidents; Accident analysis;

Accident statistics; Age factor in accidents; Michigan; Driver age; Accident responsibility; Aged drivers; Young adult drivers; Adolescent drivers

HS-010 007 Fld. 1/5; 5/3

MOTORCYCLE ACCIDENT SURVEY

by Anthony Moss

California Dept. of Hwy. Patrol

Jan 1970 38p

During the month of November 1969, 542 motorcycles involved in fatal and injury traffic accidents were surveyed for equipment modifications. The modifications surveyed were extended front forks, lowered seat, raised foot rests, irregular handlebars, and no front wheel brakes. About 1.3% of the accidents were due to these equipment modifications. Although the data indicates that the modifications surveyed increase the accident potential, the number of cases is too small to be conclusive. It is estimated that of the 15,000 motorcycle accidents expected to occur during 1970, between 50 and 350 will be due to equipment modifications. About 7.7% of the motorcycles surveyed had equipment modification. Of these 3.7% had only one modification and the remaining 4.0% had two or more modifications.

Search terms: Motorcycle accidents; Motorcycle operator injuries; Accident statistics; Motorcycle characteristics; Motorcycle operator fatalities; Accident causes; Accident studies; Environmental factors; Time of accidents; Driver age; California

HS-010 008 Fld. 1/5; 5/20

A CAMPER ACCIDENT STUDY

California Dept. of Hwy. Patrol

Dec 1970 60p
Report no. CHP-1-71-200

1/5 Statistical Data (Cont'd.)**HS-010 008 (Cont'd.)**

This study of California camper accidents was carried out in three parts: to determine existing laws and their supporting research data developed by other states; to determine and/or develop available statistics relating to accidents; to conduct an in-depth study of accidents or incidents. Other states have little or no legislation regarding campers. A total of 511 injury and fatal accidents were classified as involving a camper and selected for analysis. There were 512 campers involved in these accidents. Camper drivers tended to be older and more experienced than the average accident-involved driver; 488 persons were injured, of whom 69% were in the camper cab and 31% in the camper unit; the primary contributing factor in 3.5% of the accidents was tire failure; four accidents involved pedestrians struck by the side-mounted mirrors; accident-involved campers were newer than accident-involved trucks.

Search terms: Campers (truck mounted); Accident statistics; Driver sex; Fatalities; Accident factors; Driver experience; Accidents by vehicle age; Tire failure caused accidents; Time of accidents; Vehicle age; Pedestrian accidents; Vehicle pedestrian collisions; Mirror caused injuries; Driver age; Accident risk forecasting; Injury statistics; Accident types

2/0 HIGHWAY SAFETY**HS-010 009 Fld. 2/0****SURVEY ON ROAD SAFETY PUBLICITY**

Morgan (Roy) Research Centre Pty. Ltd., Melbourne

1962 62p

A survey on road safety representing a cross-section of 1,047 men and women

throughout Australia is presented. The data represents the habits, experiences, opinions, memories, and reactions of the pedestrians and drivers to 27 major lines of inquiry concerning road safety.

Search terms: Highway safety; Interviews; Questionnaires; Surveys; Opinion polls; Australia; Driver attitudes; Pedestrians; Safety propaganda; Mass media; Advertising; Safety program effectiveness; Public opinion

HS-010 010 Fld. 2/0**MORE BUT NOT ENOUGH. TRAFFIC SAFETY SINCE WORLD WAR 2**

by William G. Johnson

Published in *Traffic Safety* v62 n5 p16-9, 44-5 (May 1963)

Traffic safety is now a complex, major problem. This article reviews the progress in entire automobile accident and safety field from V-J Day to the Cuban crisis. Nine trends seem of major significance: vehicle use skyrocketed; many public programs have begun and grown; citizen education for safe behavior and support of officials is well advanced; programs are appraised by defined criteria; special problems—drinking drivers, young and old drivers, speed, and pedestrians—have public attention; federal activity has greatly increased; medical and health groups are more active; research has been emphasized, but is growing slowly; and national organization services and coordination are improving, though still inadequate.

Search terms: Highway safety; Community support; Safety education; Safety research; Highway safety programs; History; Accident prevention; Age factor in accidents; Program evaluation; Local government

HS-010 011 Fld. 2/0**THE FORMATIVE YEARS**

by Sidney J. Williams

Published in *Traffic Safety* v62 n5 p14-5, 42-3 (May 1963)

Presented at the Northwestern Univ. Traffic Inst., Evanston, 1946.

Traffic accidents were a grim accompaniment to the increase of good roads and use of automobiles. By 1924 motor vehicle deaths were approaching 20,000 a year. People demanded something be done about it. Traffic control signs and signals were installed. Laws and regulations were enacted to apply specifically to motorcars. A Uniform Vehicle Code was adopted in 1926, a Model Traffic Ordinance in 1928. With increasing police enforcement efforts, driver licensing and vehicle inspection grew. Accident records were more standardized, beginning about 1924. Public education and school safety programs began early in the century. But research was lacking, coordination poor until World War II.

Search terms: Highway safety; Community support; Safety education; Safety research; Highway safety programs; History; Accident prevention; Safety laws

2/4 Design and Construction**HS-010 012 Fld. 2/4****STRUCTURAL SYSTEMS IN SUPPORT OF SAFETY: NEW HIGHWAY STRUCTURES DESIGN CONCEPTS. VOL. 2. PRELIMINARY DESIGNS AND ENGINEERING DATA. FINAL REPORT**

by Joseph E. Minor; Maurice E. Bronstad

Southwest Res. Inst.

Sep 1969 97p 10 refs
Contract FH-11-6638
Report no. PB-187 782

Volume 2 of this report contains results of the program presented as artist's sketches, tabulations of engineering data, preliminary design drawings, design assumptions and criteria, and cost estimates for the fabrication of prototype structures, and subsequent procurement in quantity. Three new bridge concepts which employ cable supports are advanced as feasible structural schemes for effecting the removal of massive support structures from the area adjacent to the roadway. Two of the concepts are advanced as feasible structures for new bridge applications; these are the leaning arches bridge and the bridle bridge. The leaning arches bridge and the remaining concept, the frame bridge, are advanced as feasible structures for use in modified existing bridge applications to permit removal of hazardous interior bents and abutments. Cable-supported structures concepts for highway signs and lighting systems are also presented.

Search terms: Bridge design; Bridge approaches; Highway bridges; Sign supports; Poles; Safety design; Roadside hazards; Costs; Engineering drawings; Specifications; Design standards; Structural design

AVAILABILITY: NTIS

HS-010 013 Fld. 2/4

NEW STRUCTURES CONCEPTS FOR HIGHWAY SAFETY. VOL. 1. RESEARCH INFORMATION. FINAL REPORT

by Joseph E. Minor; Maurice E. Bronstad

Southwest Res. Inst.

Sep 1969 75p 6 refs
Contract FH-11-6638
Report no. PB-187 781

Volume I of this report summarizes research activities conducted in response to requirements for developing new, cable-supported structure design concepts that will permit removal of massive support structures from the area

adjacent to the roadway. Development efforts resulted in identification of bridge concepts and sign and lighting system concepts that are responsive to new, safety-related design criteria. Methods of structural analysis developed for some of these concepts, quantitative analyses of these concepts (with respect to projected geometric, load, and aesthetic requirements), and the definitive concept designs are summarized. Bridge concepts selected for detailed analysis and preliminary design are identified and discussed. These are the leaning arches bridge, the bridle bridge, and the frame bridge. New sign and lighting system support structure concepts selected for preliminary design are also identified and discussed.

Search terms: Bridge design; Bridge approaches; Highway bridges; Sign supports; Lighting design; Poles; Structural design; Roadside hazards; Safety design; Structural analysis; Specifications

AVAILABILITY: NTIS

HS-010 014 Fld. 2/4; 1/3; 1/4

ACCIDENT PREVENTION IN LONDON BY ROAD SURFACE IMPROVEMENTS

by L. W. Hatherly; D. R. Lamb

Published in *Traffic Engineering and Control* v12 n10 p524-9 (Feb 1971)

10 refs

Presented at Sixth World Highway Conference, International Road Federation, Montreal, 4-10 Oct 1970.

The article describes the development of a technique of improving the skid resistance of city streets at known accident sites which has resulted in a significant reduction in accident rates. The surfacing treatment consists of applying an extended epoxy binder to the road using a specially developed spraying machine and covering with

small chippings of calcined bauxite. The way in which police accident records were used to develop criteria for the selection of locations is outlined and a method of assessing the cost-effectiveness is suggested.

Search terms: Accident location; Pavement skid resistance; Epoxy resins; London; Pavement skidding characteristics; Benefit cost analysis; Surface treatment; Accident rates; Binders; Pedestrian accidents; Accident prevention

HS-010 015 Fld. 2/4; 2/5

MOTORWAY LIGHTING

by Granville Berry

Published in *Traffic Engineering and Control* v4 n12 p679-81 (Apr 1963)

4 refs

Excerpts from *Highway Lighting*, presented to the Institution of Highway Engineers, Coventry, England, 1 Mar 1963.

Highway lighting may be justified by reduced accident rates and improved use of roads at night. When lighting is installed on existing roads, accidents are reduced considerably. European and United States experience with highway lighting shows good results with various lighting schemes.

Search terms: Lighting equipment; Highway lighting; United States; Great Britain; France; Germany; Belgium; Holland; Italy

2/7 Meteorological Conditions

HS-010 016 Fld. 2/7; 5/18

WINTER TESTS FOR GREATER DRIVING SAFETY

by E. A. Whitehurst

2/7 Meteorological Conditions (Cont'd.)**HS-010 016 (Cont'd.)**

Published in *American Road Builder* v46 n11 p12-3, 16 (Nov 1969)

The National Safety Council's annual winter testing program is described. Tests are conducted of vehicle traction, including pulling capacity, stopping capacity, and cornering capacity on snow covered and ice covered surfaces. Some details are given on: construction of the driving range, maintenance of the test track, a tire testing program including studded tires. Maintenance of the testing facility and its use in training high school driving instructors is discussed.

Search terms: Test facilities; Tire tests; Studded tires; Vehicle handling; Skidding; Icy road conditions; Winter driving; Traction; Driver education

2/8 Police Traffic Services**HS-010 017 Fld. 2/8; 1/5****ARIZONA DEPARTMENT OF PUBLIC SAFETY ANNUAL REPORT 1970**

Arizona Dept. of Public Safety

31 Dec 1970 52p

This report includes data on accidents and arrests by districts, fatal accidents, and an analysis of accidents where alcohol and seat belt usage were factors. Activities of the Investigation Division are also summarized.

Search terms: Arizona; Accident statistics; Fatalities; Arrests; Seat belt usage; Drinking drivers; Accident rates; Accident location; Accident types; Driver intoxication; Police traffic services; Police law enforcement responsibilities; Time of accidents

2/9 Traffic Control**HS-010 018 Fld. 2/9****SIGN LEGENDS**

by D. C. Kneebone

Published in *Australian Road Res. Board Proceedings of the Third Conference*, Sydney, 1964 v2 pt1 p542-57

12 refs

Report no. Paper-151

The most economical upper case alphabet for sign legends is the series D alphabet, which also has the advantage of giving short word lengths for a given legibility. The legibility distance of 50 ft. per in. of letter height commonly recommended for the design of sign legends with this alphabet agrees closely with the 85 percentile legibility distance determined from the study described in this paper, and should be suitable for the design of reflectorized signs with either light backgrounds and dark letters or dark backgrounds and light letters, provided specular reflection or glare is avoided. The existing minimum standards provided for in the Standards Association of Australia Road Signs Code for the size of warning signs appear to be inadequate, and the general use of at least 30 in. by 30 in. diamond legend warning signs is recommended. Experience in New South Wales on the selection and layout of messages on advance direction signs is given.

Search terms: Sign legibility; Sign lettering; Sign standards; Australia; Reflectorized signs; Warning signs; Sign visibility; Night visibility; Sign tests; Sign color; Sign reflectance

HS-010 019 Fld. 2/9**THE PERFORMANCE AND CHARACTERISTICS OF A MAGNETIC LOOP VEHICLE DETECTOR**

by R. J. Keith; J. I. Tindall; S. T. Yan

Published in *Australian Road Research Board Proceedings of the Third Conference*, Sydney, v2 pt1 p366-87 (1964)

Report no. 156

A series of tests has been carried out on a magnetic loop vehicle detector so that the capabilities of this type of detector could be assessed both for general detection and counting purposes and also for use with an automatic traffic analyzer system. The tests included several loop configurations and covered all classes of vehicles over a range of speeds from zero to 70 mph. The effect of vehicle placement over the loop, the determination of the position of the vehicle with respect to the loop when the detector indicated the presence of a vehicle, and the headway resolution of the detector were studied in detail.

Search terms: Magnetic loop detectors; Traffic analyzers; Traffic counters; Acceleration tests; Traffic data recorders; Performance tests; Vehicle detectors; Headways; Vehicle size

HS-010 020 Fld. 2/9**TRAFFIC SIGNALS**

by K. L. Duncan

Published in *Traffic Engineering and Control* v4 n10 p564-7 (Feb 1963)

Prepared for presentation at meeting of South Wales and Monmouthshire Traffic Engineering Group, Institution of Civil Engineers.

The principal need for control by traffic signals arises where conflicting flows of vehicles become sufficiently heavy to give rise to delay or accidents. Situations with various densities and right-of-way requirements are discussed for vehicles and pedestrian traffic. Effects of various timing cycles and sequences are considered, with locations of detectors to sense traffic flow. Although British practice is described, the treatment is basic and widely applicable.

Search terms: Pedestrian control; Traffic signals; Traffic signal spacing; Turn signals; Vehicle detectors; Traffic density; Traffic control optimization; Traffic signal timing

HS-010 021 Fld. 2/9; 4/7

HIGHWAY MERGING PROBLEM WITH ACCELERATION AREA

by Hisashi Mine; Takeshi Mimura

Published in *Transportation Science* v3 n3 p205-13 (Aug 1969)

7 refs

This paper analyzes a merging problem in which a vehicle arrives at an entrance from a ramp, and waits for a chance to merge as it accelerates in the acceleration lane. The velocity of the merging vehicle at time t is a known function $v(t)$, where the time origin is the moment when the merging vehicle arrives at the entrance. The probability density function of the delay to the merging vehicle, i.e., the time between its arrival at the entrance and the moment it emerges onto the highway, is derived and a property of this function is discussed.

Search terms: Mathematical analysis; Merging capacity; Acceleration lanes; Probability theory; Traffic flow; Gap utilization; Gap acceptance; Time headways; Lane change time; Waiting time; Traffic models

2/11 Traffic Records

HS-010 022 Fld. 2/11

TRAFFIC RECORDS AND MANAGEMENT BY EXCEPTION

by James M. Slavin

Published in *Traffic Digest and Review* v18 n9 p1-7 (Sep 1970)

"Management by exception" is the name given by management experts to a procedure by which unusual or

exceptional situations come to the attention of executives who can decide what, if anything, to do about them. Management by exception has been defined as "a system of identification and communication that signals the manager when his attention is needed; conversely it remains silent when his attention is not required." The role of a traffic records system in reporting exceptions which are related to plans, standards and guides, trends, and deviations from norms is discussed. A job description for a traffic records analyst is shown and his duties and functions described.

Search terms: Traffic records; Accident records; Traffic data analysis; Highway safety organization management

3/0 HUMAN FACTORS

HS-010 023 Fld. 3/0

A SURVEY OF ROAD SAFETY IN SCHOOLS: EDUCATION AND OTHER FACTORS

by Helen V. Colborne; K. J. Sargent

England Road Res. Lab.

1971 104p 5 refs
Report no. RRL-LR-388

Questionnaires about road safety were sent in June 1968 to representative samples of schools in England, Scotland, and Wales. Replies were received from 2,213 primary and secondary schools. Few schools have set aside time for road safety teaching and many schools rely heavily on outside sources for road safety training and material. The main sources are road safety talks by police officers (in 64% of primary and 40% of secondary schools) and RoSPA posters and other material (in 88% of primary and 85% of secondary schools). There were driver or pre-driver training courses at 11% of secondary schools, and half of the head teachers of secondary schools thought that driving should be taught at school. About half of the head teachers

thought that there was a need for guidance on ways of teaching road safety to children, even though the majority thought that parents should play the main part in road safety training.

Search terms: Accident prevention; High school driving courses; Instruction materials; Child safety education; Safety education; Motorcycle safety; Adolescent drivers; Bicycle safety; Pedestrian safety; Questionnaires; Great Britain; School location; Surveys

3/1 Alcohol

HS-010 024 Fld. 3/1

A NEW GOAL FOR THE 70'S

by Douglas V. Toms

Published in *Analogy* n10 p4-9 (1970)

One of the major aspects of highway safety currently receiving top priority by the National Highway Safety Bureau is alcohol countermeasures. The distinction is made between the problem drinker who is likely to be involved in a crash and the social drinker who may occasionally drive after drinking. In the countermeasures program, emphasis will be on identification of problem drinkers through use of alcohol blood tests and rehabilitation. Nine pilot alcohol safety action projects funded by the federal government are briefly noted.

Search terms: Drinking drivers; Alcohol blood tests; Alcohol usage; Alcohol laws; Blood alcohol levels; Driver intoxication; Federal state relationships

HS-010 025 Fld. 3/1

ALCOHOL

Anonymous

Published in *Air Force Driver* p6-12, 20 (Jul 1971)

3/1 Alcohol (Cont'd.)**HS-010 025 (Cont'd.)**

Several aspects of the drinking driver problem are presented: alcohol safety action programs; the effects of alcohol on driving; the effects of impure alcoholic beverages on driving performance; blood-alcohol levels; implied consent laws. A physiological tester that would keep drunken drivers from starting their cars is described.

Search terms: Blood alcohol levels; Implied consent laws; Alcohol usage deterrents; Alcohol effects; Driver physiological test devices; Drinking drivers; Driver intoxication

HS-010 026 Fld. 3/1; 5/14; 3/12**DEATH-OR LIFE. REPORT OF THE JOINT LEGISLATIVE COMMITTEE ON MOTOR VEHICLES AND TRAFFIC SAFETY.**

New York State Jnt. Leg. Com. on M.V. & Traf. Saf.

1963 73p
Report no. Legislative-Doc-1963-76

This report reviews the work of State Senator Edward J. Speno and his committee. Areas in which laws were enacted included seat belts, tire safety, blood alcohol levels, visual acuity testing for drivers, and safety devices. A summary of legislative proposals, legislation vetoed, and proposed legislation rejected by the committee is also provided. A summary of New York State Laws passed during 1963 that affect motor vehicles and traffic safety is included as an appendix.

Search terms: New York (State); Safety laws; Seat belt regulations; Alcohol laws; Tire standards; Tire wear; Blood alcohol levels; State laws; Tire safety; Safety devices; Driver vision standards; Vision tests; Visual acuity; Drinking drivers

3/4 Driver Behavior**HS-010 027 Fld. 3/4; 2/7****SLIP, SPIN, AND SKID**

by D. W. Harmon

Published in *American Motorist* v33 n7 p16-7 (Nov 1964)

Tire manufacturers design and test their products to reduce the effects of bad weather, but the major safety factor in winter driving is the motorist. Six basic winter tips are: winterize your car; use good tires, snow tires, or chains; keep windows clear; get the feel of a slippery road; keep back from the car ahead; and learn to pump the brake gently. Apply power gradually to avoid spinning the wheels. Turn the front wheels in the direction of a rear wheel skid. Braking distances are much greater on ice, especially near melting temperature. Other slippery surfaces are: mud or oil on the road, dust wet with fog or drizzle, loose gravel on concrete, wet leaves, and steel gratings or traffic plates when wet.

Search terms: Vehicle control; Icy road conditions; Skidding; Winter driving; Wet road conditions; Accident prevention; Pavement condition

HS-010 028 Fld. 3/4; 3/6**THE YOUTHFUL DRIVER: SOME CHARACTERISTICS AND COMPARISONS**

by Patricia F. Waller

Published in *Behavioral Research in Highway Safety* v1 n3 p143-54 (Fall 1970)

2 refs

The characteristics of youthful drivers (16 through 25) are described, compared with those of other age groups, and several important preliminary implications are obtained. Comparison was

made between responses to a questionnaire sent to a sampling of all North Carolina drivers and information obtained from new driver license applicants. A two-week sampling of reported accidents in the state showed more than half involved at least one under 25-year-old driver. Comparisons of accident and violation records of young drivers before and after the sending of an advisory letter seemed to show them to be more responsive to a soft sell approach. Findings of various other comparisons include: all ages and both sexes felt the driver was the major problem in highway safety; females and nonwhites tend to obtain their licenses at a later age than males and whites; accident-involved young drivers compared with similar age drivers in the total licensed population showed males of both races are over-represented in the accident population; and accident-involved young female drivers show significantly different violation records from the general sample.

Search terms: Adolescent drivers; Young adult drivers; Male drivers; Female drivers; Driver licensing; Accident risks; Warning letters; North Carolina; Driver records; Age factor in driving; Driver characteristics; Driver mileage; Sex factors in driving; Racial factors; Sex factors in accidents

3/5 Driver Education**HS-010 029 Fld. 3/5****DEFENSIVE MOTOR VEHICLE DRIVING PLANT TRAINING COURSE NO. 59-A. STANDARD FORMAT INSTRUCTOR'S OUTLINE**

Pacific Telephone and Telegraph Co.

1 Sep 1964 185p
Report no. Issue-1

A defensive driving course was initiated for employees of the Bell System who had occasion to operate company motor vehicles. The objective of the course is to

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train drivers in basic defensive driving skills and to influence their attitudes so they will want to make it a personal responsibility not to become involved in an accident.

Search terms: Driver education manuals; Instructors; Instruction manuals; Defensive driving; Driver skills; Driver tasks

HS-010 030 Fld. 3/5

POLICIES AND PRACTICES FOR DRIVER AND TRAFFIC SAFETY EDUCATION

National Education Assoc.

1964 81p

Developed by the Fourth National Conference on Driver Education, Washington, D. C., 13-15 Nov 1963.

Recommendations for effective courses in driver and traffic safety education are presented. They are designed to provide guidance at all school levels for personnel who are responsible for planning and offering courses, providing leadership, and preparing teachers and supervisors.

Search terms: Driver education; Safety education; Classroom driver instruction; Behind the wheel instruction; Multiple car driving instruction; Instructors; High school driving courses; Instruction materials; Driver education evaluation

HS-010 031 Fld. 3/5

EXTENDED DRIVER EDUCATION LABORATORY ENRICHMENT PROJECT. APPLIED RESEARCH PROJECT

Wisconsin Dept. of Public Instruction

n.d. 17p
Report no. Bull-9-169

This project was conducted in Janesville, Wisconsin, during the 1967-68 school year. It was an attempt to help determine both the effectiveness and acceptability of the parent-assisted approach in behind-the-wheel high school driver education. The project applied a systematic coordinated approach to improving the laboratory phase of driver education through parental assistance. The testing methods are described, and it is concluded that parents can play an important role in upgrading and improving the total driver education instructional program. It is recommended that other schools utilize this approach with the findings from this applied research report. The study needs to be repeated, with improvements, to see what the real merits of this approach can be.

Search terms: Behind the wheel instruction; High school driving courses; Parents; Driver experience; Driver skills; Driver education evaluation; Wisconsin

HS-010 032 Fld. 3/5; 4/7

THE PREDICTION OF AUTOMOBILE ACCIDENTS FOLLOWING THE SENIOR YEAR IN HIGH SCHOOL

by William Asher; Beverly Dodson

Published in *Behavioral Research in Highway Safety* v1 n3 p180-95 (Fall 1970)

19 refs

One hundred and three variables were used in a sample of 799 subjects to predict non-trivial automobile accidents during the year following high school. Driver education again was found to be unimportant. Some theoretical concepts in measurement theory were used to estimate maximum magnitude of relationships. Evidence of the value of more research money for the behavioral science aspects of accidents is presented. The need for field experiments is stressed.

Search terms: Accident risk forecasting; Age factor in accidents; Sex factors in accidents; Accident rates; High school driving courses; Driver education evaluation; Adolescent drivers; Variance analysis; Psychological factors; Sociological factors

3/6 Driver Licensing

HS-010 033 Fld. 3/6

IMPROVING DRIVER-LICENSING PROGRAMS

by Robert L. Chapman

Published in *Behavioral Research in Highway Safety* v1 n3 p172-9 (Fall 1970)

A theoretical model for instituting social change via a specific highway safety program objective is presented. The use of PFC (Program-Feed-back-Change) as a model suggests that the quality of traffic safety services can best be enhanced through instituting positive driver behavioral activities, rather than screening out potential *high risk* candidates. The paradigm implies some very concrete, immediate and necessary change. This includes that administrators who are charged with driver-licensing responsibilities and evaluation must first change their point of view from that of a punitive and "tax collecting" agency of government to one of social action. This in turn suggests that these administrators must on one hand convince the political levels of government to support a new public image, and on the other hand must be willing to communicate in dramatic ways this new change to the public at large. Thus, the philosophical change must precede new program implementation.

Search terms: Driver behavior; Driver licensing; Driver improvement; Program evaluation; Highway safety programs; Research methods

OTHER SAFETY RELATED AREAS

HSL No. 71-28

3/7 Drugs Other Than Alcohol

HS-010 034 Fld. 3/7

DRIVING RECORDS OF HEROIN ADDICTS

New York State Narcotic Addiction Control Comm.; New York State Dept. of Motor Vehicles

Dec 1969 23p 5 refs
Report no. RR-1969-11

This paper examines the relationship between drug abuse and driving safety of 6,076 opiate addicts admitted to the Narcotic Addiction Control Commission. It was found that 1,245, or 20% of these addicts, had a driver's license and/or a driving record. Analysis of these records indicates that 77% of the males and 73% of the females had one or more accidents, or convictions for violation of the vehicle and traffic laws. In contrast, only about 20% of all New York State motor vehicle operators have any accidents or traffic convictions on their records. None of the addicts were licensed to operate a motorcycle, nor were any ever convicted of driving while under the influence of drugs. The records of the 1,226 male addicts showed a total of 4,465 accidents and traffic convictions, with 402 accidents involving injury or death. The results of this study indicate that drug addicts who drive are dangerous drivers. Findings suggest, however, that poor driving may be a result of problems other than the physical effects of drugs.

Search terms: Heroin; Drug addiction; Drug caused accidents; Narcotics; Driver records; Male drivers; Accident severity; Accident records

3/12 Vision

HS-010 035 Fld. 3/12

VISION AND DRIVING: A REPORT ON RESEARCH

by Albert Burg

Published in *Human Factors* v13 n1 p79-87 (Feb 1971)

13 refs

Information on vision test performance and personal and driving habits was obtained for 17,769 California drivers and was compared with their driving records, i.e., accidents and convictions for traffic citations. Of the vision tests evaluated, dynamic visual acuity is by far the one most closely related to driving record, followed by static visual acuity, visual field, and night vision. The results show that mileage, age, and sex are also important factors influencing driving record, and that conviction experience is a much more stable driving record variable than accident experience.

Search terms: California; Vision tests; Night vision; Visual acuity; Visual fields; Regression analysis; Convictions; Driver records; Driver mileage; Driver age; Driver sex; Problem drivers; Accident repeater drivers; Driver vision standards

design and statistical analysis. The use of a causal chain approach to evaluation of highway safety countermeasures is recommended. In this approach, measurements of the direct effects of a countermeasure are made, and these are related to the ultimate (accident) measure by analyzing the chain of events which follows. Three examples of this technique are given—a speed control program promoted by a police agency, a motor vehicle inspection program, and an improved ambulance system. The causal chain approach can yield rather immediate and useful results. While these measures may not be politically as satisfying as dramatic life-saving claims, they have the virtue of being more realistic indicators of the success of a countermeasure program.

Search terms: Causality; Highway safety programs; Benefit cost analysis; Program evaluation; History; Vehicle age; Accident risks; Fatalities; Drinking drivers; Vehicle mileage; Speed limits; Ambulances; Vehicle inspection

4/0 OTHER SAFETY-RELATED AREAS

4/2 Community Support

HS-010 036 Fld. 4/2

CAUSAL CHAIN APPROACHES TO THE EVALUATION OF HIGHWAY SAFETY COUNTERMEASURES

by William K. Hall; James O'Day

Published in *Journal of Safety Research* v3 n1 p9-20 (Mar 1971)

19 refs

The process of evaluation of highway safety countermeasures is examined from two points of view—evaluation at the project planning stage in which cost-effectiveness analysis is appropriate and evaluation after implementation using the techniques of experimental

HS-010 037 Fld. 4/2

SO YOU WANT TO SELL SAFETY

by Thomas L. McDole

Published in *HIT Lab Reports* p5-8 (May 1971)

Presented to Michigan Safety Conference, Motor Carrier Section, Lansing, Mich., 22 Apr 1971, under title *The Psychology of Selling Safety to the Professional Driver*.

The current safety sales method uses an indirect, soft-sell approach relying on mass media as the mode of communication. The results of this campaign have been discouraging, to say the least. The technique proposed here utilizes the opposite method, namely a direct, hard-sell campaign using extensive personal contact, which should, if vigorously pursued, have a substantial impact on safety. Suggestions are given

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for product definition, audience identification, approaching the consumer, creating a need (for the product), salesmanship, and counting the profit.

Search terms: Safety propaganda; Safety campaigns; Safety education; Psychological factors; Mass media; Driver attitudes; Consumer attitudes

4/6 Insurance

HS-010 038 Fld. 4/6

PRO AND CON ON INSURE-YOURSELF AUTO LEGISLATION

by Jack Davies

Published in *State Government* v43 n3 p152, 159-62 (Summer 1970)

10 refs

The arguments for no fault auto insurance are discussed, and details of the Minnesota and Keeton-O'Connell plans are contrasted.

Search terms: No fault insurance plan; Fault; Liability; Insurance costs; Accident responsibility; Legal costs

4/8 Transportation Systems

HS-010 039 Fld. 4/8; 4/5

STUDY OF SYNCHRONOUS LONGITUDINAL GUIDANCE AS APPLIED TO INTERCITY AUTOMATED HIGHWAY NETWORKS. FINAL REPORT

TRW Systems Group

15 Sep 1969 103p
Contract C-353-66(Neg)
Report no. TRW-06818-W666-RO-000;
PB-188 582

Cover title: High-Speed Ground Transportation 1969 Systems Engineering Study.

A computer simulation has been used to check out a synchronous longitudinal guidance (SLG) system for an automated highway network. A network space allocation technique was found to be feasible and applicable to larger more complex highway networks. This study lent additional weight to the argument that synchronous longitudinal guidance is a simple, practical, and effective method of allocating space on a fully automated ground transportation network. The key elements of the SLG concept are minimum trip time, maximum network capacity, and maximum safety consistent with design specifications. Trip time is minimized by choosing velocity profiles as high as possible consistent with safety and comfort. Network capacity is maximized by choosing the minimum slot time consistent with the velocity range in that portion of the network. Maximum safety is obtained by choosing a headway policy which insures that collisions do not occur under the expected range of operating conditions.

Search terms: Computerized simulation; Automatic highways; Guidance systems; Automatic control; Queueing theory; Network flow analysis; Traffic capacity; Headways; Travel time; Mathematical models; Algorithms; Stopping distance

AVAILABILITY: NTIS

5/0 VEHICLE SAFETY

5/1 Brake Systems

HS-010 040 Fld. 5/1

PASSENGER CAR BRAKE SYSTEM PERFORMANCE REQUIREMENTS (SAE J843a AND SAE J937)

by E. E. Prather

Bendix Corp.

Published in HS-002 162, *Service Brake System Performance Requirements for Automotive Vehicles* (SP-299), New York, 1967 p10-35

Report no. SAE-680176

Presented at SAE Automotive Engineering Congress, Jan 1968. Includes Recommended Practices J992, J843a, and J937 in appendix.

The revised Passenger Car Road Test Code, SAE J843a, provides a test procedure of improved reproducibility and a high degree of severity. The new report, SAE J937, performance requirements, are stringent and have contributed to the up-grading of passenger car brake systems and individual components. This paper describes the changes and improvements incorporated in the road test code J843a, emphasizing instrumentation and test methods. Passenger vehicle brake test data for effectiveness, fading, and water recovery are discussed in relation to the J937 performance requirements.

Search terms: Brakes; Brake design; Brake fade; Brake performance; Brake performance; Brake standards; Brake systems; Brake temperature; Brake tests; Truck brakes; Pedal force; Water effect on brakes; Compliance tests; Test equipment

HS-010 041 Fld. 5/1

THE CONSUMER'S ADVOCATE: DISC BRAKES—HERE TODAY, MORE TOMORROW

by John P. Gallagher

Published in *Road Test* v7 n9 p76-8 (Jul 1971)

First used on American cars in 1962, front disc brakes now come on about half the cars off the assembly line. They operate when friction pads clamp a rotating disc on the wheel rather than expand inside a metal drum as on the older style brakes. Cooling is better, especially on smaller wheels, and water

5/1 Brake Systems (Cont'd.)**HS-010 041 (Cont'd.)**

and dirt affect them less. Service life is usually longer and driver control better. American cars usually have front disc, rear drum systems, with a pressure proportioning valve, because of design and production problems.

Search terms: Brake design; Brake pads; Brake performance; Brake systems; Disc brakes; Drum brakes

HS-010 042 Fld. 5/1**DUAL CIRCUIT AIR BRAKE WITH SINGLE POINT CONTROL DEVELOPED FOR HEAVY-DUTY VEHICLE**

by C. F. Smith

Published in *Automotive Engineering* v79 n4 p33-5 (Apr 1971)

Design and operation of a dual-circuit air brake system for heavy duty vehicles is described. Two reservoirs prevent complete loss of air if a leak occurs. Pressure loss to 60 psi in the primary reservoir initiates a warning to the driver. Pressure loss to 40 psi actuates automatic application of the trailer brakes. No single failure condition causes the front axle to be braked without braking the other axles. Other special features, including the control valve manifold and the modulating control valve, are briefly discussed.

Search terms: Air brakes; Dual brakes; Heavy duty vehicles; Brake system design

HS-010 043 Fld. 5/1; 5/2; 5/20**DEVELOPMENT OF BRAKING PERFORMANCE REQUIREMENTS FOR BUSES, TRUCKS AND TRACTOR-TRAILERS**

by Ray W. Murphy; Rudolf Limpert; Leonard Segel

Michigan Univ. Hwy. Safety Res. Inst.

1971 37p 22 refs
Contract FH-11-7290
Report no. SAE-710046

Presented at Automotive Engineering Congress, Detroit, 11-15 Jan 1971.

This paper reports the results of a study which had as its aim the determination of braking performance currently achievable by buses, trucks, and tractor-trailers and the improvement of this performance by use of advanced braking systems. Both vehicle testing and analytical techniques, including dynamic modeling and simulation, were used in the program. Performance qualities essential to braking systems are enumerated, which, when given quantitative definition in the light of performance achievable, can form the basis of rational performance requirements for commercial vehicles.

Search terms: Braking; Dynamic models; Simulation models; Buses; Tractor trailers; Brake tests; Brake system design; Brake performance; Commercial vehicles; Brake failures; Truck brakes

AVAILABILITY: SAE

HS-010 055 Fld. 5/1; 5/20**ANTI-LOCK BRAKE SYSTEMS: WHO'LL PAY FOR SAFETY?**

Anonymous

Published in *Commercial Motor* v133 n3415 p69-70 (7 May 1971)

Installations of antilock (antskid) brakes on trucks have been successful and some persons in England suggest they be mandatory on commercial vehicles. Widespread use on cars is not expected soon. Electronic sensors give reliability and better sensitivity. Cost may be about \$100 per axle, but anti-jackknifing equipment would cost about \$600 on existing vehicles. The sensors release the

brakes if wheels start to lock and could also prevent driving axle wheelspin.

Search terms: Brake systems; Truck brakes; Antilocking devices; Antijackknifing devices; Safety device costs; Vehicle stability; Articulated vehicles

5/4 Design**HS-010 044 Fld. 5/4****MUST AMERICA DICTATE TO US? A WORRIED LOOK AT THE WAY THINGS ARE GOING**

by J. R. Daniels

Published in *Autocar* v134 n3915 p2-5 (8 Apr 1971)

The current preoccupation of the United States with clean air and safety aspects of automotive design and the implications for European car manufacturers with sizeable American markets are discussed. The validity and practicality of some of the impending car safety features are also discussed. The suggestion is made that European car manufacturers establish a realistic program of safety and antipollution aims, based on European needs, and stick to it.

Search terms: Automotive industry; European vehicles; Automobile design; Safety design; Vehicle air pollution; Air pollution emission factors

HS-010 045 Fld. 5/4**DEVELOPMENT OF AN EXPERIMENTAL METHODOLOGY FOR STUDYING MOTOR VEHICLE IMPACTS WITH FLEXIBLE SAFETY BARRIERS**

by G. L. Basso; H. F. L. Pinkney; G. F. W. McCaffrey

National Res. Council of Canada

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Oct 1970 27p 5 refs

Reprinted from DME/NAE Quarterly Bulletin No. 1970(3).

This paper reports the development of experimental test facilities for evaluating vehicle-barrier collisions. Experiments were also conducted to assess the importance of various parameters used to describe the test results and to provide information to validate a computer simulation of this type of collision. A high speed motion picture camera has been used to determine the six rigid body motions of a vehicle.

Search terms: Barrier collision tests; Computerized simulation; High speed photography; Test facilities; Test equipment; Mathematical models; Vehicle trajectories; Instrumented vehicles

HS-010 046 Fld. 5/4

ROLLS-ROYCE TWO-STAGE ROTARY ENGINE

Anonymous

Published in *Automobile Engineer* v61 n2 p30-2 (Feb 1971)

1 ref

Rolls Royce has developed a diesel version of the Wankel engine suitable for use in commercial vehicles. It incorporates a compact two-stage combustion chamber and a new apex seal design. The chamber design provides the turbulence needed for good combustion and the performance of the seals has reduced the specific fuel consumption at low speeds by 30%. Design and manufacture of the prototype two-stage version has begun, and data for this engine are compared with two competitive power units.

Search terms: Rotary engines; Diesel engines; Engine design; Apex seals; Wankel engines; Combustion chambers; Engine performance; Engine tests

HS-010 047 Fld. 5/4

DEVELOPMENT OF A HIGH TIP SPEED RADIAL TURBINE SYSTEM FOR A SMALL TURBOALTERNATOR

by Casimir Rogo

Teledyne C.A.E.

1971 18p 12 refs
Report no. SAE-710552

Presented at SAE mid-year meeting, Montreal, 7-11 Jun 1971.

The design and rig development of a 1970 fps tip speed radial turbine, volute, combustor, and exhaust as an integrated system is discussed. The components form the hot section of a United States Army turboshaft engine for powering portable electrical generator sets in the 30, 45, 60 kw range. Aerothermodynamic design highlights, rig testing, and modifications necessary to meet design objectives are covered.

Search terms: Turbine engines; Engine design; Aerodynamic configurations; Turboalternators; Generators; Engine tests; Engine speeds; Mathematical models

AVAILABILITY: SAE

HS-010 048 Fld. 5/4

MANUAL OF STANDARD PRACTICE FOR HUMAN FACTORS IN MILITARY VEHICLE DESIGN

by Robert E. Hedgcock; John W. Lewis; Francis M. McIntyre

Army Human Engineering Labs.

Aug 1962 96p 20 refs
Report no. TM-21-62; AD-285 379

Human factors engineering recommendations for military vehicles in the areas of operability, maintainability, and safety are listed. These recommendations are

oriented toward use by human factors specialists. Neither the areas of interest nor the contents of these areas is exhaustive. An attempt has been made to indicate relational values of various recommendations in order to facilitate trade-off decisions.

Search terms: Human factors engineering; Military vehicles; Maintainability; Vehicle design; Control equipment; Safety design; Display systems; Interior design

AVAILABILITY: NTIS

HS-010 049 Fld. 5/4

1971 CRASH TEST REPORT

Anonymous

Published in *California Highway Patrolman* v35 n2 p10-3 (Apr 1971)

The Insurance Institute for Highway Safety results from its low speed crash cost tests of twelve 1971 car models are discussed. The test results show that long available techniques to provide cars with energy absorbing bumpers and no-damage exteriors continue to be ignored in the design and manufacture of new cars being sold to consumers today. Repair costs are above what they were in 1970. It is recommended that the automotive industry do away with ornamentation and lethal shapes which regularly impact pedestrians and bicyclists, and use proper self restoring and energy absorbing structures.

Search terms: Automobile design; Crashworthiness; Safety design; Automobile repair costs; Energy absorbing bumpers; Low speed impact tests

HS-010 052 Fld. 5/4; 5/6

DETROIT'S '71 MODELS FEATURE NEW ENGINES, EASY SERVICE

Anonymous

5/4 Design (Cont'd.)**HS-010 052 (Cont'd.)**

Published in *Product Engineering* v41 n20 p13-7 (14 Sep 1970)

New features to be found in 1971 cars include easier serviceability and maintainability and engines that can operate on low lead-content gasoline. Only a few safety features have been included. The biggest emphasis is on the marketing of new small cars designed to compete with the imported car market. Aspects discussed include use of silicon in aluminum engines; devices for controlling evaporative emissions and oxides of nitrogen; anti-skid devices.

Search terms: Aluminum; Transmission controlled spark; Evaporative emission control devices; Antiskid devices; Serviceability; Compact cars; Silicon; Engine design; Nitrogen oxides; Maintainability; Safety devices

5/6 Fuel Systems**HS-010 050 Fld. 5/6****EFFECT OF UNLEADED FUEL ON LUBRICANT PERFORMANCE**

by W. W. Crouse; R. H. Johnson; W. H. Reiland

Sun Oil Co.

1971 7p 1 ref
Report no. SAE-710584

Presented at SAE mid-year meeting,
Montreal, 7-11 Jun 1971.

The performance of motor oils in engines run on unleaded fuels was evaluated using several makes of United States cars. These oils, SAE 10W-40 grades, were run in high mileage or turnpike service, as well as suburban service. The performance with unleaded

fuels was not significantly different from that for leaded fuels in the areas of wear, sludge, varnish, or rust. Valve seat recession was detected in several of the cars, but had an effect on performance in only one case. Further testing using laboratory engines and a patrol fleet in pursuit service demonstrated the effect of lubricant composition on valve seat recession. In addition, it was found that engines preconditioned on leaded fuels afforded better protection against valve seat recession than new engines.

Search terms: Lead free gasoline; Lubricating oils; Performance tests; Lubricating oil tests; Gasoline quality; Engine wear; Valves; Engine performance; Corrosion tests; Engine operating conditions

AVAILABILITY: SAE

HS-010 051 Fld. 5/6**EXHAUST EMISSION CONTROLS**

Anonymous

Published in *Motor Age* v90 n4 p85-8 (Apr 1971)

Several automobile features designed to reduce or control exhaust emissions are described. These include both open and closed crankcase ventilation systems changes in ignition timing, and fuel evaporation controls.

Search terms: Exhaust emission control devices; Positive crankcase ventilation; Crankcase ventilation systems; Ignition timing; Evaporative emission control; Crankcase emission control

HS-010 053 Fld. 5/6**INFLUENCE OF HOMOGENEOUS CHARGE ON THE EXHAUST EMISSIONS OF HYDROCARBONS, CARBON MONOXIDE, AND NITRIC****O X I D E F R O M A MULTICYLINDER ENGINE**

by R. Lindsay; A. Thomas; J. A. Woodworth; E. G. Zeschmann

Shell Res. Ltd. (England)

1971 15p 23 refs
Report no. SAE-710588

Presented at SAE mid-year meeting,
Montreal, 7-11 Jun 1971.

A fuel-air mixture generator has been developed which allows a vehicle to be run on a chassis dynamometer under both transient and steady-state conditions on premixed homogeneous gasoline-air mixtures using conventional nonleaded gasoline. Under these conditions cylinder-to-cylinder-variations of air/fuel ratio, and of carbon monoxide emission from a 90 cu. in. 4-cyl. engine were virtually eliminated, and variations of NO emissions were greatly reduced. However, variations of hydrocarbon emission were scarcely affected. With the premixed charge the vehicle could be run on an extremely lean air-fuel mixture, while retaining good driveability. At an air/fuel ratio of 22.5/1, CO and NO emissions over the U.S. Federal cycle according to the 1970 test procedure were 2.7 and 0.4 g/mile, respectively. However, unburned hydrocarbon emissions exceeded current legislative requirements.

Search terms: Exhaust emissions; Hydrocarbons; Carbon monoxide; Nitric oxide; Air fuel ratio; Dynamometers; Air flow; Engine speeds; Lean fuel mixtures; Laboratory tests; Exhaust emission tests

AVAILABILITY: SAE

HS-010 054 Fld. 5/6**EFFECT OF COMBUSTION CHAMBER SURFACE TEMPERATURE ON EXHAUST HYDROCARBON CONCENTRATION**

by J. T. Wentworth

General Motors Corp.

1971 16p 21 refs
Report no. SAE-710587

Presented at SAE mid-year meeting,
Montreal, 7-11 Jan 1971.

The relationship between surface temperature and exhaust hydrocarbon concentration was explored by installing surface thermocouples at three locations in the combustion chamber of a single-cylinder engine. Coolant temperature, coolant passage surface scale, and ethylene glycol in the coolant affected exhaust hydrocarbon concentration through changes in surface temperature. As power output increased, combustion chamber surface temperature rose, and exhaust hydrocarbon concentration fell. The increase in surface temperature accounted for about 43% of the decrease in hydrocarbon concentration. The reason for the other 57% of the decrease is unknown, but it may have been caused by increasing gas temperatures in the quench zone. Increasing surface temperature by engine modification would be expected to have adverse effects on engine octane requirement, volumetric efficiency, and oil oxidation.

Search terms: Combustion chambers; Hydrocarbons; Thermocouples; Ambient temperature effect on exhaust; Single cylinder engines; Engine performance; Exhaust emissions measurement; Coolants; Octane requirements; Engine operating conditions

HS-010 056 Fld. 5/6

1971 CARS AND THE "NEW" GASOLINES

by W. E. Morris; J. D. Rogers, Jr.; R. W. Poskitt

Du Pont de Nemours (E. I.) and Co.

1971 58p 13 refs
Report no. SAE-710624

Presented at SAE mid-year meeting,
Montreal, 7-11 Jun 1971.

Lower compression ratio engines and low-lead gasolines were investigated by comparing fuel economy and acceleration performance of eight matched pairs of 1970 and 1971 automobiles. In addition, road octane requirements were obtained on 43 1971 cars with 3,000 and 12,000 deposit miles. A total of 146 unleaded, low-lead, and leaded regular gasolines obtained at service stations throughout the country were analyzed. Average fuel economy of 1971 cars was found to be 6.6 percent lower; acceleration was significantly poorer than that of the 1970 cars. Leaded or unleaded gasolines of 91 research octane level are expected to knock in more than half the 1971 cars; however, research octane number is a poor index of road octane performance.

Search terms: Automobile performance; Engine performance; Engine design; Compression ratio; Knock; Antiknock ratings; Leaded gasoline; Lead free gasoline; Fuel composition; Fuel economy; Gasoline consumption; Octane requirements; Road tests; Acceleration

AVAILABILITY: SAE

HS-010 057 Fld. 5/6

THE DIESEL SMOKE TEST CONTROVERSY

by Jack Lyndall

Published in *Fleet Owner* v65 n12 p51-4
(Dec 1970)

The state of New Jersey has recently proposed a law regulating visible diesel smoke emissions from trucks that the New Jersey Motor Truck Association and bus operators feel is unreasonable and goes beyond existing technology's ability to meet. The law requires the diesel truck to pass a free acceleration test. As a reasonable, workable alternative, the truckers propose an alternate full load smoke test that averages smoke opacity readings over a 10-second run. A turbocharged engine could not pass the free acceleration test.

Search terms: Turbocharging; Smoke; New Jersey; Diesel engine exhaust emissions; Exhaust emission tests; Acceleration; Smoke meters

HS-010 058 Fld. 5/6

HOW TO OBTAIN THE DESIRED SHAPE OF THE FUEL-AIR RATIO CURVE IN TWO-STROKE CYCLE GASOLINE ENGINES

by Alfred Jante

Technische Univ., Dresden (East Germany)

1971 11p 10 refs
Report no. SAE-710577

Presented at SAE mid-year meeting,
Montreal, 7-11 Jun 1971.

The effects of fuel-air ratio on speed have been shown to depend on the phenomena taking place in the carburetors of two-stroke gasoline engines. These phenomena and the subsequent reactions in the engine are described. Methods of reducing adverse effects are presented and computations for estimating vibrational limits of fluid flow in different types of carburetors with and without damping devices are given. It is shown that a constant fuel-air ratio over a wide range of speeds is important to economical operation of two-stroke cycle engines.

Search terms: Air fuel ratio; Two stroke cycle engines; Intake systems; Engine speeds; Oscillation; Carburetors; Damping; Fluid flow; Resonators

5/10 Lighting Systems

HS-010 059 Fld. 5/10

SIDE LIGHTS AND LOW-BEAM HEADLIGHTS IN BUILT-UP AREAS

Stichting Wetensch. Onderz. Verksvlghd.
(Neth.)

5/10 Lighting Systems (Cont'd.)**HS-010 059 (Cont'd.)**

1969 69p 24 refs
Report no. SWOV-1969-7

The question whether side lights or low-beam headlights are to be preferred regarding road safety in built-up areas was investigated. The results indicated that both low-beam headlights and side lights have certain drawbacks. It is advisable to seek a lighting system for the front of motor vehicles which lacks these drawbacks but preserves the advantages. This can, for example, be achieved with a light of an intensity between the present low-beam headlights and side lights, guaranteeing adequate conspicuity with an acceptable degree of glare. The use of such side lights, however, implies that the public lighting must also be taken into account.

Search terms: Headlamp usage; Side-marker lamps; Netherlands; Accident causes; Pavement reflectivity; Low-beamed headlights; Headlamp glare; Street lighting; Headlamp brightness; Vehicle visibility; Urban areas; Lighting design; Day vs night accident risks

HS-010 060 Fld. 5/10**THE PERFORMANCE OF TWO SELF-LEVELLING HEADLAMP SYSTEMS**

by J. S. Yerrell

England Road Res. Lab.

1971 24p 2 refs
Report no. RRL-LR-378

The effectiveness of a correctly aimed headlamp can be lost by changes in the attitude of the vehicle body. These are largely the result of alterations in the static load carried, but can also come from sustained acceleration and deceleration. This effect can be countered in a relatively simple way by automatically

altering the setting of the headlamps. The performance of two self-levelling headlamp systems, one mechanical and one hydraulic, has been investigated. Both behaved well during static loading, correcting well for changes in rear, central and front loading. Dynamic tests which vibrated the front and rear wheel pairs separately up to a frequency of 9 Hz showed a tendency for the mechanical system to resonate under certain conditions, but driver tests indicated that this was unlikely to occur under normal driving conditions. Drivers found the independent movement of the headlamps most noticeable with the mechanical system, particularly on rough and uneven surfaces.

Search terms: Headlamp aiming; Headlamp tests; Level controlled headlamps; Headlamp leveling; Hydraulic equipment; Static tests; Dynamic tests; Static loads; Road tests; Loads (forces)

5/11 Maintenance and Repairs**HS-010 061 Fld. 5/11****AUTOCARE MANUAL PT. 1**

Anonymous

Published in *Autocar* v134 n3912 p1-8 (Mar 1971)

This manual for car owners explains the fundamentals of an engine, how to attend to your car, and how to talk about any problems which may come up, with the authority of knowledge behind you. Part 1 discusses: lubrication (how it works); oil pumps; oil filters; routine maintenance; crankcase ventilation; checking and servicing positive crankcase ventilation systems; diagnosing faults; timing chains and belts.

Search terms: Manuals; Lubrication systems; Oil filters; Oil pumps; Crankcase ventilation systems; Positive crankcase ventilation valves; Camshaft drives; Automobile maintenance

5/14 Occupant Protection**HS-010 062 Fld. 5/14****AIR BAG EFFECTIVENESS SHOWN IN TWELVE CONTROLLED CRASHES**

by James F. Martin; David J. Romeo

Published in *Automotive Engineering* v79 n7 p15-9 (Jul 1971)

To establish baseline data on air bags for the National Highway Traffic Safety Administration, Cornell Aeronautical Laboratory crashed 12 cars that had been retrofitted with currently available devices. The results confirm that the bags perform well in the situation they were designed for—an adult driver or right front occupant, sitting back, away from the instrument panel at the time of impact, in a straight frontal crash—but do not offer the best protection in other situations. Some suggestions offered are: matching bag stuffers to cars, and wider bags that would reduce the chance of sliding off in an angled impact.

Search terms: Air bag restraint systems; Injury prevention; Occupant protection; Impact tests; Anthropometric dummies; Restraint system effectiveness; Panic stops; Air bag inflation pressure

HS-010 063 Fld. 5/14**SHOULDER BELT UTILIZATION**

by Theodore E. Anderson

North Carolina Univ. Hwy. Safety Res. Center

Feb 1971 25p 5 refs

This study was designed to provide an estimate of the percentage of drivers using an available shoulder belt during normal driving. A total of 1,707 field observations of drivers moving in traffic were collected in North Carolina, and analysis of this data revealed an overall

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shoulder belt utilization rate of 10.06% in rural areas and 6.41% in urban areas. Male drivers had a utilization rate of 9.51% compared to female drivers' utilization rate 4.82%. Drivers operating small foreign vehicles used the shoulder belt more often (19.86%) than drivers operating vehicles manufactured in the U.S. (5.96%). Apparent driver age was another important factor, young drivers (utilization rate 11.15%) were found to use shoulder belts more than either mature (7.16%) or older drivers (5.32%). Also, drivers operating vehicles registered out of state were found to have a higher utilization rate (12.19%) than drivers of North Carolina registered cars (7.19%). Results of this study revealed that shoulder belt utilization is relatively small for all groups.

Search terms: Shoulder harness usage; Urban areas; Rural areas; Sex factors; Age factors; Vehicle size; North Carolina; Racial factors; Vehicle registration

5/15 Propulsion Systems

HS-010 064 Fld. 5/15

CURRENT TRENDS IN ELECTRICS

by Bill McCarty

Published in *Automotive Fleet* v10 n2 p29-33 (Dec 1970)

Current use of electric vehicles in this country and Great Britain is discussed. The anti-pollution efforts in this country have revived interest in this type of vehicle because of its lack of exhaust emissions. A number of companies are developing prototype cars, some for low-speed limited range, in-town transportation, and in a few cases medium high speed, longer range vehicles. Most problems are associated with the batteries supplying the power and problems involved in recharging them.

Search terms: Electric vehicles; Electric automobiles; Batteries; Battery charging; Great Britain; United States; Electric automobile range

HS-010 065 Fld. 5/15

THE WANKEL ENGINE. A SELECTED BIBLIOGRAPHY 1960-1970

by Dorothy M. Harby, comp.

General Motors Research Labs. SASI

Feb 1971 24p 304 refs
Report no. SASI-71-381

Items for this bibliography have been selected from the System on Automotive Safety Information file, Engineering Index 1955 to date, British Technology Index 1962 to date, Industrial Arts Index 1955-57, Applied Science and Technology Index 1958 to date, and other interested sources. The bulk of the material is drawn from English journals, with some report literature and German, Italian, and French articles.

Search terms: Wankel engines; Bibliographies

5/17 Safety Defect Control

HS-010 066 Fld. 5/17; 5/9

FAULTS IN CARS—A SURVEY

by Geoffrey Howard

Published in *Autocar* v134 n3911 p2-5 (11 Mar 1971)

Data from Swedish inspection tests of 886,037 automobiles are reported. Brake systems, front suspension, steering systems, and exhaust system defects are discussed. The results show that it is entirely wrong to judge the reliability of cars by their country of origin. The expected life in service of a number of these cars is also reported.

Search terms: Defective vehicles; Brakes; Front suspension systems; Steering systems; Exhaust systems; Automobile defects; Sweden; Brake systems; Vehicle inspection; Service life

5/18 Steering Control System

HS-010 067 Fld. 5/18

MEASUREMENT OF VEHICLE HANDLING BY TETHERED TESTING

by N. F. Barter

Published in *Institution of Mechanical Engineers Proceedings* 1969-70 v184 pt2A n11 p219-32

9 refs

Presented at Automobile Division meeting, London, 28 Apr 1970. Includes discussion and author's closure.

The technique of tethered testing is introduced as a method of measurement of vehicle steady state handling, where the vehicle under test is attached to a large parent vehicle by means of an arm attached at its centre of gravity, and the tire forces, which in the normal free vehicle situation produce a centrifugal acceleration, are simply reacted by this arm. It is shown that the concept of tethered testing leads naturally to the idea of describing vehicle steady state handling by means of a quantity which depends only on lateral acceleration, and suitable quantities are shown to be static margin and the slope of a curve of mean front wheel steer angle against vehicle slip angle. These quantities are defined and their derivation in terms of vehicle stability derivatives is outlined in an appendix. Some examples of tethered test measurements are given in the form of plots of static margin against lateral acceleration, and a tentative set of criteria for good steady state handling is given in terms of the behavior of static margin with lateral acceleration.

Search terms: Vehicle handling; Tethered tests; Vehicle stability; Steady state; Vehicle center of gravity; Lateral acceleration; Computerized simulation; Static margin; Yaw; Roll; Slip; Steering force; Mathematical analysis

**5/18 Steering Control System
(Cont'd.)**

HS-010 068 Fld. 5/18

**VEHICLE HANDLING
QUALITIES**

by F. D. Hales

Published in *Institution of Mechanical Engineers Proceedings 1969-70 v184 pt2A n12 p233-48 (1970)*

13 refs

Presented at Automobile Div. Ordinary Meeting, London, 28 Apr 1971. Includes discussion by A. W. Cristie, A. S. Davies, P. W. R. Stubbs, R. S. Sharp, V. E. Gough, and D. H. James, and author's reply.

Quantitative methods of analysis are presented for the general steady-state motion of an automobile and, in particular, for methods that are able to assess the nonlinear characteristics of vehicles. Three basic handling concepts are considered: understeer, static margin, and slip/steer gradient. Following the analysis of the perturbation motion about steady circular motion, the concepts are rationalized and related to the theoretical vehicle behavior. The relationship among the three concepts is investigated and subsidiary vehicle parameters highlighted. It is concluded that the concepts of understeer, static margin, and slip/steer gradient can be successfully applied theoretically to the general non-linear cornering motion of an automobile, and that experimental techniques exist that yield measurements from which quantities defined by the theoretical analysis can be obtained.

Search terms: Vehicle handling; Steady state; Vehicle characteristics; Understeer; Vehicle stability; Tethered tests; Turning; Cornering; Yaw; Equations of motion; Mathematical analysis; Static margin; Lateral force; Test equipment; Steering; Speed

HS-010 069 Fld. 5/18

THE WING'S THE THING

by Forrest K. Bond

Published in *Air Force Driver v4 n12 p4-7 (May 1971)*

Aerodynamic devices (spoilers or wings) are available as accessories or factory options on many super cars or pony cars. Adapted from racing cars, the devices are opposite in effect from their aircraft counterparts; they are designed to hold the cars down more firmly onto the pavement. Are they needed at legal highway speeds? A rear wing or large spoiler lip on the trunk lid can reduce wind lift at the rear, but increase it in front, with adverse effects on high speed stability. A good, front spoiler (mounted under and behind the bumper) can increase front wheel loads, improving steering stability at about 70 mph and above.

Search terms: Aerodynamic configurations; Body aerodynamics; Weight distribution; Automobile modification; Automobile stability; High powered automobiles; Automobile handling

HS-010 070 Fld. 5/18; 5/6

MEASURING VEHICLE DRIVEABILITY

by R. L. Everett

General Motors Res. Labs.

1971 12p 14 refs
Report no. SAE-710137

Presented at Automotive Engineering Congress, Detroit, 11-15 Jan 1971.

Emission controls, both exhaust and evaporative, have made it much more difficult to achieve satisfactory driveability. Since driveability is becoming a more critical factor, objective rating techniques are desirable. A surgemeter has been developed for objectively measuring vehicle surge, one driveability factor. A comparison of surgemeter ratings with surge ratings of expert drivers indicate that the surgemeter objectively measures surge. In one investigation, the surgemeter indicated

that vehicle surge increased as the amount of exhaust gas recirculation required for NO_x control increased. In another investigation, the surgemeter was used to compare surge in seven different vehicles as part of a more comprehensive vehicle driveability rating program. Good, overall vehicle driveability implies that the driver is satisfied with the automobile's power train operation. Driveability measurements generally employ subjective "seat-of-the-pants" techniques, and jargon to describe performance. These techniques and jargon are described and defined.

Search terms: Surgemeters; Driveability; Surge; Power trains; Exhaust gas recirculation; Engine operating conditions; Coldstarts; Engine performance; Nitrogen oxides; Exhaust emission control; Acceleration

AVAILABILITY: SAE

HS-010 071 Fld. 5/18; 5/20

**TRUCK FRAME ANALYSIS
STUDY**

by Oskar Michejda

Indiana Inst. of Tech.

1971 13p 19 refs
Report no. SAE-710594

Presented at SAE mid-year meeting, Montreal, 7-11 Jun 1971.

A method of truck frame analysis is proposed to include the effects of forces acting in three dimensions as well as the effects of variable cross sections, off shear-center loading, and joint flexibility. The interaction between the frame and other components of the vehicle is discussed and a method is proposed to include these effects in the static and dynamic stress analysis of the frame components. The dynamic effects on stresses are proposed to be included in experimentally determined dynamic stress factors defined in terms of dimensionless probability density functions for

various frame components and on - and off-highway conditions. An experimental program is outlined for the evaluation of stiffness characteristics of the flexible joints, the upper bound of the horizontal force acting at the front axle, and the dynamic stress factors. General analysis of forces and deformations in the chassis due to drive-shaft impact and twisting of the vehicle is included.

Search terms: Trucks; Frames; Mathematical models; Dynamic structural analysis; Stress analysis; Vehicle dynamics; Structural deformation analysis; Ground roughness; Torque; Stiffness; Front axles; Rear axles; Topographical factors; Mathematical analysis; Lateral force

AVAILABILITY: SAE

5/20 Trucks and Trailers

HS-010 072 Fld. 5/20; 1/3

PILOT STUDY OF HOUSE-TRAILER AND TRUCK CAMPER SAFETY. PHASE 1. FINAL REPORT

by C. W. Wojcik; R. L. Mellinger

California Univ. ITTE

Sep 1970 128p 373 refs
Report no. UCLA-Eng-7084; PB-195 449

The objective of this study was to determine the nature of accidents involving housetrailers and truck campers, to establish the prevailing causes of these accidents, and to define the problem areas which later can be investigated more thoroughly. During the first year of this research program, efforts were concentrated on: survey of literature related to stability and performance of truck campers and housetrailers, and collection and preliminary analysis of data on accidents involving these vehicles. The survey of literature consists of a comprehensive list of references, abstracts of publications related to articulated vehicles, and a review of

recent contributions in the field of mechanics of vehicles in general, and in the field of dynamics of articulated vehicles in particular. The preliminary analysis of the reports indicates clearly that the problem of driver control of these types of vehicles (particularly housetrailers) is more difficult than that of passenger vehicles.

Search terms: Campers (truck mounted); Recreational vehicles; Reviews; Articulated vehicles; Tire properties; Accident statistics; Mobile homes; Vehicle dynamics; Tire properties; Aerodynamics; Accident causes

AVAILABILITY: NTIS

HS-010 073 Fld. 5/20; 4/5; 5/18

TRUCK SUSPENSION SYSTEM OPTIMIZATION

by Bruce D. Van Deusen

Chrysler Corp.

1971 12p 12 refs
Report no. SAE-710222

Presented at Automotive Engineering Congress, Detroit, 11-15 Jan 1971.

This paper describes a test program and computer simulation aimed at optimizing the riding qualities of a military tractor semitrailer combination, the Heavy Equipment Transporter (HET). Instrumented testing at the U.S. Army Aberdeen Proving Ground was conducted with a variety of suspension configurations. The test data were recorded on magnetic tape and converted into digital data for computer processing. The test results were correlated with computer simulation. The computer model was then used to perform a sensitivity analysis of various suspension parameters. With rms acceleration at the vehicle frame used as a criterion for optimization, an improved suspension configuration was defined. The techniques for test data analysis and computer simulation are described and preliminary results are presented.

Search terms: Suspension systems; Computerized simulation; Military vehicles; Vehicle riding qualities; Tractor semitrailers; Truck performance; Truck tests; Acceleration; Road tests

AVAILABILITY: SAE

HS-010 074 Fld. 5/20; 5/18

A TORSIONAL STRENGTH ANALYSIS OF TRUCK FRAMES USING OPEN SECTION MEMBERS

by Kunihiro Takahashi

Nissan Motor Co. Ltd. (Japan)

1971 13p 11 refs
Report no. SAE-710595

Presented SAE at mid-year meeting, Montreal, 7-11 Jun 1971.

A new method of torsional strength analysis has been developed for truck frames with open-section members. The conventional analytical methods often indicate values 2-20 times smaller or larger than the actual stress because the actual load transmission between the frame members is different from generally accepted theory. In the present study, the stress distribution was measured in detail with an effective strain meter and the nature of the load transmission was made apparent. In the author's new method of analysis, this load transmission is taken into consideration, and the calculated values correspond closely to the experimentally measured values.

Search terms: Stress analysis; Frames; Strain gauges; Structural analysis; Mathematical analysis; Loading (mechanical); Truck design; Load transfer; Torsional vibration; Rigidity

AVAILABILITY: SAE

5/22 Wheel Systems**HS-010 075 Fld. 5/22; 4/7****A MATHEMATICAL MODEL FOR A TIRE SIDEWALL**

by S. K. Clark; I. K. McIvor

Published in *Rubber Chemistry and Technology* v43 n5 p1055-69 (Sep 1970)

2 refs

Recent measurements of the cord loads in the sidewall of a tire show that extreme asymmetry exists in this load as the deflected tire rolls. Such cord load fluctuations cannot be explained by bending considerations, which are completely symmetric with respect to the centerline of the contact patch, and so other mechanisms must be responsible for them. An examination of this problem shows that shell membrane effects can satisfactorily explain the observed loads. A simple mathematical model for the tire sidewall is proposed based on this concept. Analysis of the model is carried out and numerical results are given which closely parallel experimental data.

Search terms: Tire cords; Mathematical models; Tire sidewalls; Tire loads; Tire force measurement; Tire road contact forces; Stress measurement

HS-010 076 Fld. 5/22**RESEARCH FOR A UNIFORM QUALITY GRADING SYSTEM FOR TIRES. 4. TREAD WEAR**

by F. C. Brenner; A. Kondo

National Bureau of Standards

Published in *Rubber Chemistry and Technology* v44 n1 p106-21 (Mar 1971)9 refs
Contract FH-11-6090

This research had as its objective the development of a test procedure for rating tires for tread wear. The results of preliminary experiments on roads for different composition and severity are discussed. The authors conclude that the course on which tires are to be rated should include several different pavements and a variety of maneuvers of unequal severity. Two courses, one near Bryan, Texas, and the other near San Antonio, Texas, were designed on this principle. Eighteen brands of tires including bias, radial, and G78 belted bias tires were run on each course. The tires ranked in order of decreasing projected mileage on each course were highly correlated, although the mileages were not equal.

Search terms: Tire tests; Tire wear measurement; Tire tread depths; Tire pavement interface; Bias belted tires; Radial tires; Tire rotation; Road tests; Proving ground tests

HS-010 077 Fld. 5/22; 4/1**THE ECONOMICS OF REGULATED SAFETY**

by John F. Floberg

Published in *Rubber World* v163 n6 p65-7 (Mar 1971)

Presented to American Management Association, 16 Apr 1970.

The rise of the consumer protection movement is outlined and the doctrine of manufacturers' liability discussed. The Department of Transportation regulations dealing with automobile and tire safety are discussed. It is estimated that the tire industry has had to spend \$25 to \$40 million on test equipment to comply with these regulations.

Search terms: Consumer protection; Tire safety; Tire test equipment; Tire standards; Safety standards compliance; Automobile safety standards; Safety standards costs

HS-010 078 Fld. 5/22; 5/1; 5/18**VEHICLE TEST METHOD FOR MEASURING TIRE-ROAD BRAKING TRACTION CHARACTERISTICS**

by F. D. Smithson

General Motors Proving Ground

1971 18p
Report no. GM-Eng-Pub-A-2713

This report presents an analysis of a vehicle testing technique for measuring tire-road braking traction characteristics. The technique involves measuring vehicle deceleration values with only the front brakes applied. Correlation data is presented to show comparison to a force measuring ASTM trailer.

Search terms: Rear wheels; Tire tests; Deceleration; Tire traction; Wet road conditions; Brake tests; Tire road contact forces; Front wheels; Mathematical analysis; Braking; Vehicle weight; Tire rolling resistance; Tire brake force; Pitch; Vehicle stability

NHTSA DOCUMENTS**NHTSA Contractors Reports****HS-800 474 Fld. 5/14****NOISE AND INFLATABLE RESTRAINT SYSTEMS. FINAL REPORT**

by C. H. Allen; R. D. Bruce; C. W. Dietrich; K. S. Pearsons

Bolt, Beranek and Newman, Inc.

30 Apr 1971 82p 31 refs
Contract DOT-HS-006-1-006
Report no. BBN-2020

The effect of the air bag inflation noise on hearing has been studied with respect to: establishing tentative criteria for exposure to air bag noise; finding the noise levels expected in the vehicles; and

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estimating the percentage of the population whose hearing might be permanently affected by widespread exposure to the noise of inflatable restraint systems. On the basis of a comparison of the noise due to a full set of 1970 experimental air bags with tentative criteria, it was estimated that 15% to 30% of the exposed population could experience hearing damage. From the limited scientific literature and the latest experience of others currently doing research in the field, it is concluded that various special groups of people (the young, the aged, or those with hearing related problems) are not substantially different from the normal population. The noise of air bag inflation can be reduced without affecting the safety performance. This noise reduction could be achieved through suitable design modifications of inflation devices and the bag itself.

Search terms: Noise exposure; Air bag restraint systems; Hearing; Noise tolerances; Air bag inflation devices; Impulse noise; Noise control; Acoustic measurement; Ear injuries; Deafness; Noise standards

AVAILABILITY: NTIS

HS-800 496 Fld. 4/4; 4/2

A NATIONAL PROBLEM-SOLVING SYSTEM: HIGHWAY SAFETY RESEARCHERS AND DECISION MAKERS. FINAL REPORT.

by Ronald G. Havelock; Elizabeth A. Markowitz

Michigan Univ.

May 1971 270p refs
Contract FH-11-6900

The relationship between research and decision-making on a wide range of highway safety issues was studied. The study was subdivided into defining and describing the highway safety research community and identifying nationwide key decision makers on safety matters.

Both of these were studied intensively with regard to two critical areas: alcohol and occupant protection. Researchers and decision makers were surveyed by interview and questionnaire. It was found that both a research and development and a decision maker community can be identified, with an elite group of research opinion leaders forming a bridge between the two. Although there is diversity of views within both communities, the approach to highway safety tends to follow one of two courses: modifying driver behavior as the key factor (led by the auto industry and state and local governments), or using a variety of countermeasures (led by the federal government). The study recommends viewing the highway safety effort as a problem solving system, increasing the research effort, and improving communications between the research and the decision-making communities.

Search terms: Decision making; Highway safety programs; Questionnaires; Automotive industry; Alcohol usage; Occupant protection; Priorities; Problem solving; Opinion polls; Safety research; State government; Local government; United States government

AVAILABILITY: NTIS

HS-800 497 Fld. 5/14

STUDIES OF INFLATING RESTRAINT SYSTEMS. FINAL REPORT

by D. H. Robbins; A. W. Henke; V. L. Roberts

Michigan Univ. Hwy. Safety Res. Inst.

15 Mar 1971 158p 22 refs
Contract FH-11-6962
Report no. HSRI-Bio-M-71-2

Report for 1 Jan 1969-1 Jan 1971.

A total of 126 impact sled tests using dummy test subjects was conducted to study the protective potential of right front passenger inflating restraint

systems. The experimental program consisted of: selection and fabrication of a restraint system configuration based on the state of the art in 1969; and testing relative to parameters, such as crash velocity, use or non-use of lap belts, occupant size, impact direction, crash deceleration pulse, and occupant position. Test results were correlated with predictions of a purely mathematical model. Restraint performance was marginally acceptable for six year through 95th percentile male dummies in front impact up to 40 mph. Performance was satisfactory with most out-of-position occupants. Recommendations were to vary parameters from the fixed geometry used, and improve the design of anthropometric dummies and establish their correlation with human impact response.

Search terms: Air bag restraint systems; Impact tests; Impact sled Head on impact tests; Deceleration tests; Occupant kinetics; Injury prevention; Anthropometric dummies; Mathematical models; Restraint system effectiveness; Seat occupation; Seat belt usage; Human body size; Occupant positioning; Impact angle

AVAILABILITY: NTIS

HS-800 498 Fld. 3/2

ANALYSIS OF DAISY TRACK HUMAN TOLERANCE TEST FINAL REPORT

by James H. McElhaney; Verne Roberts; D. Hurley Robbins

Michigan Univ. Hwy. Safety Res. Inst.

10 Feb 1971 170p
Contract FH-11-6962
Report no. HSRI-Bio-M-71-1

An analysis is presented of film and transducer records from a series of impact tests, using the Daisy deceleration sled, on human volunteers conducted at the 6571st Aeromedical Research Laboratories at Holloman Air Force Base, New Mexico. The purpose of

**NHTSA Contractors Reports
(Cont'd.)**

HS-800 498 (Cont'd.)

test program was to compare lap belt versus lap belt air cushion restraint systems. The analyses indicated that the lap belt plus a rapidly inflated air cushion performed significantly better than the lap belt alone by reducing head motion, linear head acceleration, shoulder motion and resultant neck and head injury.

Search terms: Human body impact tolerances; Human body kinetics; Human deceleration tolerances; Impact tests; Impact sleds; Head movement; Restraint system effectiveness; Seat belt effectiveness; Seat belt tests; Air bag restraint systems; Deceleration tests; Shoulder motion range

AVAILABILITY: NTIS

HS-800 499 Fld. 5/14; 4/7; 1/2

**INJURY CRITERIA MODEL FOR RESTRAINT SYSTEM EFFECTIVENESS EVALUATION.
FINAL REPORT**

by D. H. Robbins; R. G. Snyder; V. L. Roberts

Michigan Univ. Hwy. Safety Res. Inst.

30 Apr 1971 106p 131 refs
Contract FH-11-6962
Report no. HSRI-Bio-M-71-3

Report for 1 Jul 1969–31 Oct 1970.

This report describes an injury criteria model, formulated in computer language and a restraint system effectiveness index for evaluating the degree to which the vehicle environment can prevent or reduce occupant injuries. The injury criteria model consists of three parts: an injury rating based on available human tolerance data including type of injury, seriousness and the magnitude of physical quantities such as force and acceleration which are related to injury production; a relative motion criterion

based on the extent to which adjacent body segments can move with respect to one another; and an index giving the probability of the crash event being studied. The analytical effectiveness index is hypothesized to be a function of the parameters defining a restraint environment (occupant, vehicle interior and restraints, and crash definition), the probability that an occupant will be using the vehicle location for which the restraint system is provided, and the probability that the restraint system will be in use by the occupant. The models are based on an extensive review of the literature.

Search terms: Restraint system effectiveness; Mathematical models; Injury research; Injury severity; Seat occupation; Occupant protection; Occupant vehicle interface; Human body impact tolerances; Acceleration tolerances; Impact forces; Crashworthiness; Computerized simulation; Injury causes; Injury prediction; Impact tests; Accident risk forecasting; Restraint system usage; Accident simulation; Test volunteers

**NHTSA Staff Speeches,
Papers, etc.**

HS-810 165 Fld. 3/1

**THE RELATIONSHIP OF
ALCOHOL ABUSE TO HIGHWAY
SAFETY**

by Robert B. Voas; Len Tabor

National Hwy. Safety Bureau

1970 19p

Presented to the Women's Conference of the National Safety Congress, 24 Oct 1970.

The program of the National Highway Safety Bureau is outlined for reducing alcohol-related accidents. Emphasis is placed on identifying and controlling drivers with a drinking problem. Alcohol

is pinpointed as playing a significant role in approximately 50% of all fatal traffic accidents.

Search terms: Drinking drivers; Alcoholism; Driver intoxication; Alcohol education; Alcohol laws; Alcohol usage deterrents; Highway safety; Blood alcohol levels; Accident factors; Problem drivers; Social drinking

HS-810 171 Fld. 3/1

**IMPROVED METHODS OF
MEASURING BLOOD ALCOHOL
LEVELS**

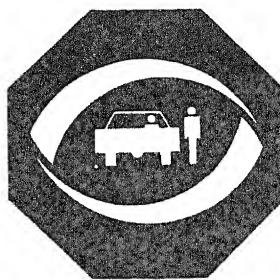
by Robert B. Voas

National Hwy. Safety Bureau

Feb 1970 25p

Three applications of alcohol detection devices are described. One is a portable alcohol breath test device that could be used by a law enforcement officer in a roadside test to apprehend intoxicated drivers. The second is a blood alcohol test device for field use. A third application is for a self-measurement device for public education programs.

Search terms: Alcohol breath tests; Blood alcohol levels; Alcohol blood tests; Drinking drivers; Driver intoxication; Test equipment; Alcohol education



executive summary

A SYNOPSIS OF A RECENTLY RELEASED NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION RESEARCH REPORT

A STUDY OF THE EFFECTS OF LAW ENFORCEMENT TRAFFIC FLOW BEHAVIOR - FINAL REPORT

The purpose of this contract was to research and evaluate the effects of moving and stationary marked police patrol vehicles on traffic flow behavior by setting up test situations in appropriate relationship to highway topography, expected traffic levels, and other relevant conditions so that the effects of driver reaction may be observed on a computer-sensor system. Also, to examine the effects of stationary traffic enforcement devices and traffic flow; and to identify the criteria for the selective assignment of police traffic units.

Contract FH-11-7476
Institute for Research in Public Safety
Indiana University
400 East Seventh Street
Bloomington, Indiana 47401
DOT/HS-800 505-
PB-201 647

Award Amount: \$100,000.00
Period of Research:
January 1, 1970 through
December 31, 1970

Objectives

The general objective of this study was to evaluate the effect of various methods of enforcement on traffic flow behavior. The effect of law enforcement in general was the major concern, but special attention was paid to distinguishing the different effects of several basic types of enforcement symbols and activities. Thus, the collection and analysis of data concentrates on documenting the manner in which both moving and stationary police activities affected a series of different measures of traffic flow. The ultimate objective of the study is to reduce traffic accidents by devising a methodology for predicting the effect of various law enforcement activities on traffic behavior.

The specific objectives of the project are to:

- Review and summarize published research both on methods of measuring traffic flow and on the effects of enforcement on traffic flow.
- Measure the effects of stationary marked police vehicles on traffic flow behavior.
- Measure the effects of moving marked patrol vehicles on traffic flow behavior.

- Measure the effects of enforcement by radar, Vascar, and other stationary speed-timing devices on traffic flow behavior.
- Investigate the effect of various alternative enforcement methods on traffic flow behavior.
- Collect and examine records of accidents occurring on the monitored highways in relation to measures of enforcement level.
- Correlate information about accidents and concurrent variations in traffic flow caused by different methods of enforcement, with a view to identifying criteria for the selective assignment of police traffic units.

Literature Review

The literature review considered more than eighty documents concerning the measures used to define traffic flow and the effects of enforcement of traffic laws on traffic flow behavior. Numerous studies have sought to identify those variables which influence the measures of traffic flow. In some instances these studies applied sophisticated statistical techniques to a number of variables believed to influence vehicle speeds, and their methods and conclusions assisted the

present researchers in selecting those measures of the behavior of traffic flow most worthy of investigation. Studies which examined the effect of law enforcement on measures of traffic flow generally showed that traffic does respond to enforcement. However, the nature and degree of this response was not consistently reported and some of the data were suspect because of the obtrusiveness of the measuring devices employed.

Methodology

An unobtrusive measuring device served to maximize the quality of the data for this study. This measuring system consisted of magnetic loop detectors connected via rented telephone lines to an IBM 1800 system located in the Institute. Fourteen locations on State Route 37 in Monroe County, Indiana, were instrumented for collection effort. Each vehicle which passed over a sensor location produced signals which the computer received and stored. These signals related to velocity, length, headway, location, direction, and lane of travel.

To see how traffic reacts to the presence of a police vehicle, both stationary and moving police cars were introduced into the highway environment. A variety of stationary police vehicle set-ups was tested, including a radar vehicle, a vehicle in an arrest situation, and two police vehicles in a "pack" configuration. Also sampled were civilian and unmarked and marked police vehicles.

For the moving enforcement vehicle tests, 19 Indiana State Police vehicles were equipped with low-power transmitters. Compatible receivers located at 12 sensor sites translated police vehicle passages into computer compatible signals. These signals were collated with the basic vehicle information to individually identify the police vehicle in permanent computer storage.

Analysis of the data produced the following results:

First, the presence of a stationary enforcement vehicle tended to decrease significantly both the speed of the traffic flow and the proportion of speed violators. The amount of the decrease varied with the density of the traffic. It also varied in proportion to the "perceived severity" of the symbol, i.e., the greater the threat of enforcement the stationary vehicle represented, the more the traffic reacted. However, the effect of the more severe symbols also tended to taper off more quickly than the effect of the less severe symbols.

Second, moving enforcement vehicles also tended to reduce both the speed of traffic flow and the incidence of speed violators. Such effects, however, were less than those induced by a stationary vehicle and lasted over a shorter distance.

MAJOR FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

Findings and Conclusions

Findings concerning the comparative effects of stationary and moving enforcement symbols upon traffic flow behavior are summarized as:

- Stationary enforcement symbols significantly lowered traffic speeds and percentages of speed limit violators, but did not significantly affect overall traffic headways, percentages of headway violators (i.e., of "tailgaters"), nor the standard deviation of traffic speed distributions. Moving enforcement symbols lowered traffic speeds to comparable, although somewhat smaller, degrees.
- Actual decreases in traffic speeds and percentages of speed limit violators produced by the various stationary symbols varied under different traffic density conditions, extending for clearly demarcated distances in each lane of traffic, but no farther than 3.2 miles in either lane for any symbol under any density level. Moving enforcement symbols also were observed to lower traffic speeds for measurable distances ahead and behind in both lanes. Unlike stationary symbols, moving enforcement symbols demonstrated maximum effects upon traffic speeds at some distance ahead of the enforcement vehicle, rather than immediately adjacent to it. In all, the effects of moving symbols extended for shorter overall distances.
- Stationary enforcement symbols lowered the speeds of, and percentages of speed violators in nearby traffic, in direct proportion of the "severity" of such symbols; i.e., to the extent to which passing motorists might be expected psychologically to interpret such symbols as posing an arrest "threat." At extended distances, however, these effects were inversely proportional to symbol "severity."
- The effects of both stationary and moving symbols were generally greater in the same, rather than in the opposite lane of traffic.

- The shapes of spot speed distributions at roadway points of maximum effectiveness were generally "normal" - i.e., Gaussian - before, during, and after the periods when stationary symbols were introduced. In other words, the normality of such distributions was on the whole unchanged by the enforcement symbols during overall shifts to lower speeds in both lanes of traffic. Although infrequent, changes due to the presence of stationary symbols appear to have been in the direction of non-normality, rather than toward increased normality.
- The effects of both stationary and moving enforcement symbols upon traffic speeds dissipated rapidly after these symbols were removed.
- Finally, due to the relatively low level of accidents and non-significant change in the overall level of enforcement, no statistically significant relationships could be established between enforcement activity and local accident occurrence.

Recommendations

While the above findings extend and make more precise knowledge of the effects of visible enforcement vehicles on traffic flow behavior, they raise further questions, in that only the bare beginnings have been realized in the amount of useful information brought forth by this study data.

First, a more elaborate project examining moving enforcement should be attempted. Pragmatically, to assure the appropriate enforcement presence, funding should be provided to cover the cost of on-duty enforcement personnel involved in the study.

Second, it is clear that much of the previous research effort in this area needs to be replicated over extended roadway systems to determine how far the effects of known determinants of traffic flow persist down the highway. Thus, the effects of various kinds of roadway obstructions, entrance and exit configurations and anomalous events (e.g., accidents) should be examined as previously in this study, over entire portions of a test road or roadway network. Expanded findings of the sort would have practical applications in such areas as highway design and safety, placement of roadway warning signs and so on.

Third, the findings of this study might well be extended to cover the effects of entire classes of available stationary enforcement resources, including different uses of actual vehicles, the use of permanent "dummy" vehicles and "dummy" accidents and so on, in different speed zones under different traffic conditions.

One final possible area of further study has to do with the components of perceived arrest threat, i.e., the psychological factors underlying driver reactions to stationary symbols of differing severities. In particular, the effects stationary symbols had upon traffic speeds appeared in many cases to vary as logarithmic functions of distance, a phenomenon which might indicate the possibility of developing a predictive science of traffic law compliance. Thus, it may well be that driver reactions to enforcement symbols may accurately be predicted as functions of both distance and time, using well established techniques from that branch of mathematical psychology known as psychophysics.

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The Contract Technical Manager has certified that the contractor's work has been satisfactorily completed and that all contractual obligations have been met.

The opinions, findings, and conclusions expressed in this summary are those of the contractor and not necessarily those of National Highway Traffic Safety Administrator.

Availability: This report may be ordered in paper copy (PC) or microfiche (MF) from NTIS. Order by DOT/HS-800 505 or PB-201 647.

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